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To the Membership

THE STRENGTH of the Congress lies in its members—those who have made surveying and mapping their life work.

As in all organizations, there are members in the Congress who carry the main load, who actively participate in the work of the Congress—on its committees, in its Technical Division, as contributors or staff workers on the Congress Journal.

There is, however, as in other organizations, a large segment of "passive" members in the Congress who are content merely to pay their dues. This is important, of course, but these members can make an additional contribution with just a little effort. If you feel that the Congress is doing a worthwhile job, pass that on to your friends or colleagues who are not acquainted with the objectives and work of our organization.

A dual-stamped, folding postal card "application form" is enclosed with this issue of the Journal for this purpose. Recommend membership by endorsing the last line of the application side of the card, address it to your friend on the mailing side, and drop it, properly folded, in the mail box.

Every member should enroll at least one new member in 1948

—EXECUTIVE SECRETARY

April • May • June • 1948

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Announcement of Awards

Special Prize Contest, 1947

IT HAS BEEN my privilege to serve as Chairman of the Special Prize Contest Award Committee for 1947 of the American Congress on Surveying and Mapping. All of the papers presented as entries for the awards evidenced considerable effort and time on the part of those submitting them. The titles and subject matter of these papers covered a wide range of subjects and were all quite interesting and worthy of consideration.

The members of the award committee were purposely chosen from a variety of backgrounds, but with the one common denominator of a real and intense interest in surveying and mapping. The members, who preferred to remain anonymous, included the following:

(1) An editor of a monthly engineering technical publication.
(2) A research geodesist.
(3) A university professor teaching surveying and mapping.

All papers submitted were read carefully by each member of the Committee and each judge made his selection upon the basis of technical information, reader appeal, and manner and clarity of presentation.

All of the entries were then submitted to a second group who again reviewed them, and the first and second choices were identical for both groups. The paper "Time for Action," by Prof. Fred C. Morris of Blacksburg, Va., was selected for the first award, which carries with it a prize of $100. The paper on "Astronomic Azimuths in Alaska and Canada," by Lt. H. J. Seaborg, U. S. Coast and Geodetic Survey, was the second choice with an award of $50.

It is to be regretted that all who submitted entries could not have received prizes. To all who contributed articles, winners and non-winners alike, the Committee wishes to express its appreciation and gratitude for the effort and co-operative spirit which made possible the many fine papers presented. To each one of you our sincere thanks. Through the coming issues of SURVEYING AND MAPPING all of our members will have the opportunity of reading for themselves these papers. The Committee is certain that all of them will be enjoyed by our members.

The Chairman of the Committee also wishes to thank publicly those persons who so generously gave of their time to review and judge the entries, anonymous as they prefer to remain, and was particularly gratified that the two groups, unknown to each other, agreed in their first- and second-choice selections.

The prize winning papers follow.

GEORGE H. HARDING, *Chairman*
Special Prize Contest Committee

Time for Action

By PROF. FRED C. MORRIS

CIVIL ENGINEERING DEPARTMENT, VIRGINIA POLYTECHNIC INSTITUTE

INADEQUATE land surveys have been the source of much trouble for many years. Boundary lines are so vaguely described that it is practically impossible to locate them with any degree of accuracy. This condition has led to much ill-feeling between neighbors, expensive litigation, and the loss of land or money in one way or another. With the increase in the value of land and the improvement in surveying equipment, it would seem that there would be a corresponding improvement in the quality of surveys; however, if there has been any improvement, it has hardly been perceptible. Most states have licensing laws that require a surveyor to pass an examination before he is permitted to practice surveying but this merely shows that he knows how to make a good survey, and it does not guarantee that he will make good ones. As a matter of fact, every registry of deeds is chocked full of extremely poor surveys that were made by state certified surveyors. It is evident, then, that licensing alone is not sufficient to cure anything.

As in many other things, the basic difficulty is an economic one since the surveyor makes just as much money on a poor survey as he does on a good one. The client, the lawyer, and the registrar of deeds do not know anything about surveys or how to check them; consequently, anything is recorded that the surveyor presents. Here is where the egg is laid that hatches into a great deal of trouble in the future. The system under which the private surveyor operates practically forces him into doing poor work. If he charges enough to do good work, some other surveyor comes along and underbids him and gets the job. These low price jobs result in low grade work because the surveyor, human nature being what it is, is not going to do any more than he has to. This condition has made it almost impossible for the man who wants to do good work to stay in business. The net result of these conditions is that the client doesn't get much of a survey and the surveyor doesn't get much money. Good surveys for good pay would certainly be a much better arrangement for all concerned. The surveyors do not have an organization of their own to promote professional ethics or to improve their work and economic status. Actually, the surveyors need help and leadership but no organization is offering either.

Every year engineering societies have their annual, national, regional, and state meetings. And every year those who attend these meetings mourn and deplore the condition of land surveys. College teachers add their bit to the chorus, as all agree that something should be done about it. The meeting adjourns until the following year when the very same story is repeated. It seems that after so much talk it would eventually occur to someone to take some realistic steps toward doing something about it. It is definitely time for action. The engineering colleges could do a great deal if they were to step forward and provide the leadership that is so sorely needed in the field of surveying and mapping. The college teachers, however, should not be expected to add this work to an

Selected for first prize in the 1947 Special Prize Contest.

already too heavy teaching load. Neither should it be handled by the civil engineering departments lest it be relegated to the stepchild status that has befallen surveying and mapping subjects in these departments. It should be handled by those who have been employed for that particular purpose so that it will be given undivided attention. It is hardly fair to criticize conditions unless you have something to offer that has promise of giving some measure of relief; therefore, let us look at things a little closer to see what might be done to improve the situation.

Most engineers have had for years recourse to periodicals that furnish them a medium of exchange of technical knowledge. This is an excellent thing because it keeps the members of the profession well informed on the new and better ways of doing things. It also furnishes a wealth of background material that creates interest and develops perspective. Until recent years, the surveyors have not had a comparable medium of exchange of knowledge and ideas. This long-felt need has been met by the American Congress on Surveying and Mapping in the form of its publication SURVEYING AND MAPPING. Even though this is an excellent publication with every issue full of interesting and informative articles, those who need it most are not getting it and they don't know that it is being published. It is indeed doubtful if more than 10 percent of the registered surveyors and engineers have ever heard of it.

Without a contact with the men in the profession, it is difficult for the national organization to propose and execute movements for the improvement of the practice of surveying and mapping. It seems, then, that the first thing to do to establish contact would be to devise some effective means to get more private surveyors and engineers in the organization. This is not a new idea as it has undoubtedly been the objective from the beginning; however, it does not alter the fact that there are too few members for the Congress to accomplish the good that it might. They are putting out good information but the receiving end is not connected up. It seems that it would be wise to take certain well-calculated steps to increase the membership so that every state has a reasonably strong representation.

To contribute toward this objective, it is suggested that the State Sections of the American Society of Civil Engineers be requested to send a circular letter to all the registered surveyors and engineers in their respective states explaining the benefits that may be derived from membership in the American Congress on Surveying and Mapping. The ASCE would probably be glad to give this assistance to an allied professional society. It may be possible to induce the state engineering colleges to co-operate with the ASCE in this undertaking. If so, so much the better. This would furnish excellent promotional experience for the members of the ASCE student branches at the engineering colleges. The surveyors and engineers are more apt to react favorably to suggestions of organizations from within their state than from those from without. Since the national organization is purely non-profit and is operated solely for the welfare of the profession, there should be no hesitancy on the part of state institutions in recommending it to the members of the profession. It is quite probable that there are many surveyors and engineers who would like to subscribe to SURVEYING AND MAPPING but have never heard of it. They should at least be given the opportunity to get it.

In regard to the periodical SURVEYING AND MAPPING, there are certain things that might be worth considering. For instance, it might be well to establish a

question box for the benefit of those who have come across particularly difficult problems in their work. These questions could be answered by staff members or other readers of the magazine. Selected articles dealing with aerial surveying and mapping could be reprinted from *Photogrammetric Engineering*. Articles on the activities of the federal surveying and mapping agencies would prove to be interesting and serve as background material. The old "Geodetic Letters" formerly published by the Coast and Geodetic Survey had some excellent ones in them. In general, there should be many articles dealing with the everyday problems of the surveyor and written in a language that he can understand. In particular, there should be much information and encouragement on the formation of state branches of the national organization.

So far, the direction of the affairs of the national organization has been top-heavy with employees of the federal surveying and mapping agencies. These men deserve much credit for their unselfish contributions to the formation and operation of the Congress; however, for the good of all concerned, it would probably be better to shift more of these responsibilities to private members as the membership increases.

For instance, it might be well for each state to have a man from private practice or from an engineering college on the Advisory Board. This man could serve as a contact between the national organization and his state members. His services would also be quite valuable in establishing a state branch of the Congress. Whether it be a church, a lodge, or any other association of people, the members are more co-operative if they are made to feel that they are an important part of it and are given something to do. This supplies nourishment to the ego and frequently it gets results where all other methods fail.

The American Congress on Surveying and Mapping can be very helpful to private surveyors and engineers, but there are many services that it cannot perform. For instance, practically every time an engineering project is undertaken there is a mad search for survey and map data. No one knows what exists or where it is. Just as much time and energy is lost in looking for data that doesn't exist as is lost in finding data that does exist. From the point of view of common sense and efficiency, this condition just about represents low-tide. In order to help to remedy this situation, it is suggested that the American Congress on Surveying and Mapping initiate a movement to induce, encourage, and abet the Land Grant Colleges in establishing engineering extension service in the field of surveying and mapping. This is a natural and logical function for these schools; therefore, the proposal should make sense to those of reason. The work of the extension should include the following:

1. To gather and preserve survey and map information that may be of service to private surveyors, engineers, and others, and to make this information readily available to those who need it.

2. To place a card index in every courthouse of all the control points in that particular county so that those who have use for the information can get it without delay. There should also be a list of the maps of the area that may be secured from the extension service and the price per copy. An arrangement should be made with the federal surveying and mapping agencies to send copies of their data to the extension office as it is established. The extension office can then keep a master index for the whole state and send copies of these to the county offices.

3. To assist the private surveyors in organizing a state branch of the American

Congress on Surveying and Mapping, and to hold an annual meeting of the organization to discuss the problems and welfare of the members of the profession. One of the main objectives of the organization should be to devise means to discipline the members of the profession who follow unethical practices that result in poor work and pay for all.

4. To conduct annual short-courses for surveyors to teach computations, the use of curves in surveying, the drawing of plats, the writing of deed descriptions, and the use of the State Plane Coordinate System.

5. To prepare standard specifications and procedures for the various classes of surveys, including the requirements for connecting surveys to the State Coordinate System.

6. To administer the State Coordinate System and check all surveys before they are connected to it.

7. To assist private surveyors in improving their surveys and their economic status. A system of standard charges would do a great deal to help eliminate the evil of underbidding. A formula could probably be devised that would enable different surveyors to arrive at about the same fee for any given piece of work. A formula of this nature should reflect the difficulties of terrain, accuracy requirements, the number of angles measured, and the number of feet measured. The price should include the field work, the computations, drawing the plat, and the writing of the deed description.

8. To assist municipalities in establishing control systems, in planning subdivisions, the use of plane coordinates, and the planning of aerial surveys and maps.

9. To prepare and publish information on the following subjects:

(*a*) Complete specifications and procedures for the various classes of surveys, including samples of standard forms.

(*b*) Procedures for the use of the State Plane Coordinate System.

(*c*) The cardinal points of law in boundary surveying.

(*d*) The legal responsibilities of land surveyors.

10. To encourage the instructional department of the college to revise its curriculum to embrace the scientific advancements in the field of surveying and mapping, particularly in regard to precise surveying and photogrammetry.

The services outlined in the foregoing can be performed by the engineering extension divisions of the Land Grant Colleges at a relatively moderate cost. The engineering colleges have never offered any leadership in this field of work and it would be the height of unwarranted optimism to expect them to do anything unless there is serious and continuous provocation.

The next problem to be solved is to find a method to get action on the part of these institutions. If you were to write to them and request that they do "something" to improve the condition of surveys and maps, you may rest assured that the status quo will be serenely maintained. Why not, then, request them to do specific things and show them how they can do them?

To follow this idea through, it is suggested that the American Congress on Surveying and Mapping appoint a committee to formulate complete plans for the operation of engineering extension work in this field. These plans should include, of course, a statement of the services to be rendered, space requirements, the personnel and their qualifications, and a preliminary budget estimate. The selection of personnel is of the greatest importance since whether a thing works or not depends to a large extent on who is trying to make it work. After these plans have been completed, some dynamic personality who is eligible to do so, should present them at the annual meeting of the Association of Land Grant Colleges; and the administrative officers of the different schools should be given a copy of them. This will serve to introduce the subject but the chances are that it still won't get action; therefore, the "heat" will have to be turned on a little stronger.

The State Section of the ASCE could very easily send a copy of the plan to all registered surveyors and engineers and request their support of the project. If the men in the field endorse the plan, these endorsements should be presented to the college with a request for action. If the college agrees to institute this service and places a request in the budget for the money, then the man in the field should support the college in the legislature in getting the appropriation.

The Land Grant Colleges should have developed extension work in surveying and mapping many years ago. They have failed to perform one of their natural functions, and have, at the same time, failed to capitalize on some very valuable state-wide contacts. The agriculturists, for instance, have their county agents, home demonstration agents, and high school teachers of agriculture who form the field workers for a very powerful lobby in both state and national government. Engineers are supposed to be resourceful but they have not acquired the ability to get the public support that their public services justify. They have been content to accept peacefully whatever is given them, if anything, and then they have to be resourceful to be able to operate at all on the meager funds they get. State-wide contacts would be a very big advantage to engineering schools in securing appropriations sufficient to operate on an efficiency basis.

Engineering extension work in surveying and mapping is just one step toward the ultimate goal—a State Bureau of Surveys and Maps. If the ultimate can be attained in one step, so much the better. This bureau would take over the extension services of the college and perform many additional ones, such as making local control surveys to supplement the federal control net, establishing the boundaries of political subdivisions, and devising a system to check all surveys before they become a part of public records. The use of the Plane Coordinate System is highly desirable but its use will be greatly restricted until more control points are made available. If a state bureau is established, it would be quite plausible for it to be connected to the engineering college since the work of the bureau and the instruction in precise surveying and photogrammetry could be closely co-ordinated.

In making the foregoing proposals it has been anticipated that there will be many who will say "unworkable, impossible, no money." It is suggested that those with such opinions ponder this one pertinent thought: Those who do things never look for reasons why something cannot be done but only for ways to do it. Vision, imagination, driving energy, and enthusiasm have accomplished many things that the mild mannered man would consider unattainable. "No money" is a stock reply that is frequently used because it is easier to do nothing than to make the effort that is necessary to get the money. In this instance, as in many human affairs, the great need is good leadership.

Astronomic Azimuths in Alaska and Canada

By H. J. SEABORG

LIEUTENANT, U. S. COAST AND GEODETIC SURVEY

AS EVERY engineer and surveyor knows, before a ground layout or survey can be of much use it must have a somewhat rigid control of orientation on the ground. In land surveys a predetermined azimuth must be applied along one line, with all other lines referred to this initial azimuth.

With regard to long and extended arcs of first-order triangulation as executed by the United States Coast and Geodetic Survey the azimuths of the lines involved become very important, and it is necessary to make precise astronomic determinations of the azimuth of a number of lines along the chain of triangulation figures.

During recent years the basic triangulation net has been extended, by way of upper Canada, into the interior of Alaska, bringing the area into the North American datum of 1927. Making a connection with pervious work at White Pass, Alaska, the arc was carried along the White Pass and Yukon Railroad to Whitehorse, Canada; thence along the Alaska Military Highway to Fairbanks. Spanning the Yukon River the arc continued to Norton Sound on the west coast where it turned to the north and west to carry through the Seward Peninsula to Little Diomede Island, thus affording a connection with European and Siberian triangulation, as soon as the Union of Soviet Socialist Republics has carried its triangulation to that point. From Fairbanks one spur follows south along the Richardson Highway to Valdez while another follows the Alaska Railroad to Anchorage and then continues out along the Alaska Peninsula. There are several cross ties between the main arcs of triangulation. (*See* fig. 1.)

In the course of this work astronomic azimuths in the higher latitudes were observed for orientation control. The purpose of this article is to bring out the methods and procedures in obtaining these precise azimuths.

GENERAL REMARKS

The first problem was to select the method of observing and the instrument that would give the desired accuracy of azimuth when working in latitudes ranging between 57 and 66 degrees north. It was decided to employ the micrometer method, observing on Polaris at or near eastern elongation. Some other close circumpolar star could have been used, but Polaris is now practically always used in the Northern Hemisphere, as its identity is positive and certain tables have been devised for simpler calculations of the final result. The micrometer method is by no means a new procedure. Up to this time, however, the Coast and Geodetic Survey had had little occasion to use this method and had never employed the Bamberg broken-telescope astronomic transit for the purpose of azimuth determination. The Bamberg instrument is perhaps not too widely known so a short description may be in order.

BAMBERG BROKEN-TELESCOPE TRANSIT

The Bamberg transit is primarily designed for making latitude and longitude

Selected for second prize in the 1947 Special Prize Contest.

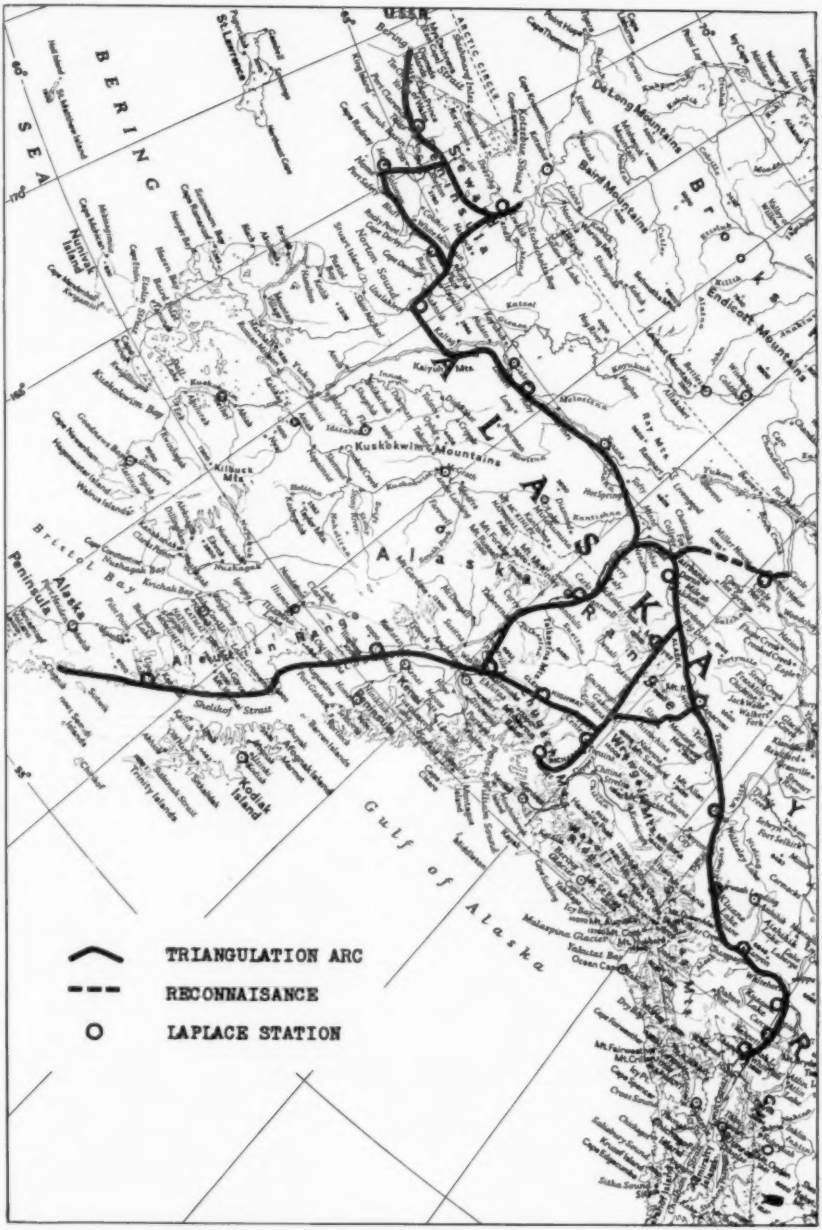

FIGURE 1.—Map section showing triangulation ares and location of Laplace stations.

observations. However, if the star and the mark are in the same vertical plane within about 10 to 15 minutes of arc, the angle between the star and the mark can be measured with the Bamberg transit using the longitude micrometer eyepiece. For azimuth observations, the longitude eyepiece is fitted on the open end of the hollow horizontal axis. Light passing through the objective of the relatively short telescope tube is reflected at right angles by a prism placed at the center of the instrument. The movable wire slide of the transit micrometer eyepiece is caused to move across the field of view by turning either one or both of the two small handwheels, which are rigidly attached to the same shaft. Usually the two wheels are turned simultaneously to give a more uniform motion. (*See* fig. 2.) A graduated micrometer drum indicates the relative position of the slide wires. Two fixed parallel wires about 50 seconds of arc apart and at right angles to the movable wires indicate the path of the star as it moves across the field of view. There being no horizontal circle on this instrument, only small differences of horizontal angles between objects nearly in the same vertical plane can be measured indirectly with the use of this longitude micrometer. As used in azimuth work the small angle between the star and the collimation axis is measured in the plane defined by the collimation axis of the telescope and the horizontal axis of the transit; and the small angle between the collimation axis and the azimuth mark is similarly measured.

There are three foot screws which rest on small footplates when the instrument is mounted on the tripod. The three-legged aluminum tripod supports the transit at such a height that the observer can make his observations in a comfortable sitting position. The flat tripod head allows for considerable movement in centering the instrument over the station mark.

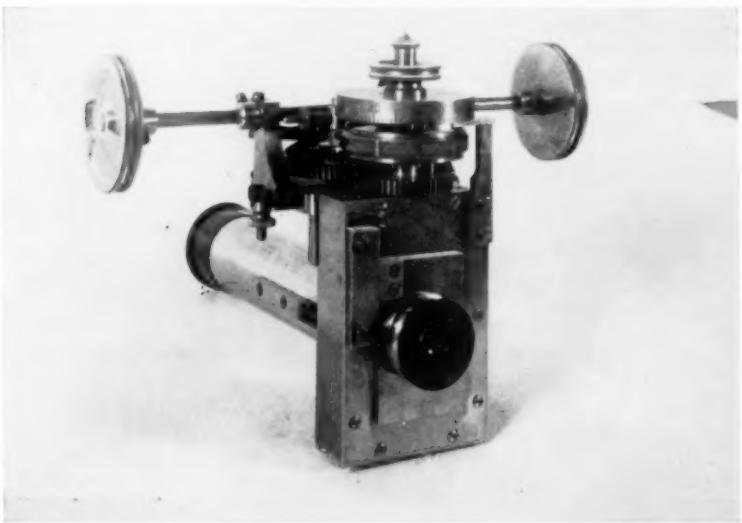

FIGURE 2.—The longitude micrometer eyepiece of the Bamberg transit.

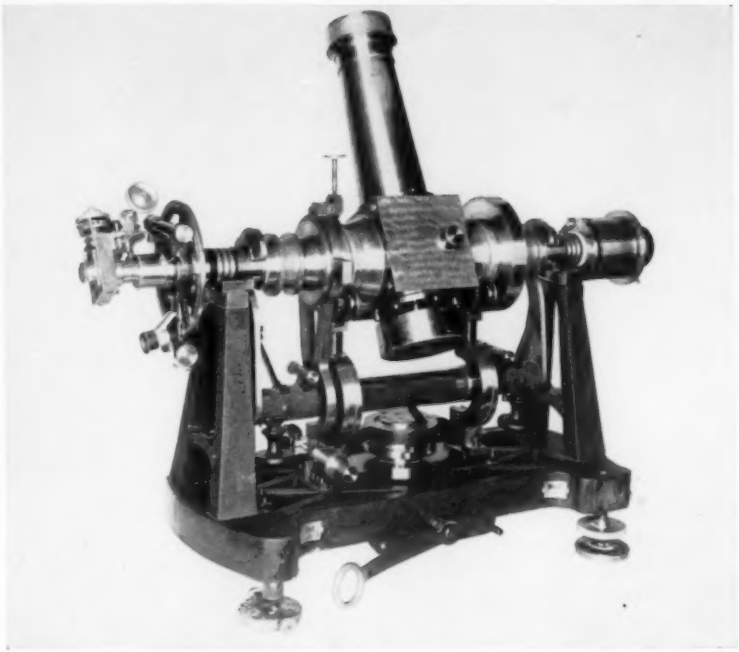

FIGURE 3.—Close-up of the Bamberg broken-telescope transit with the longitude eyepiece mounted on right end of the horizontal axis.

This instrument is quite heavy but is carefully counterpoised and a portion of the weight rests on springs, thus preventing undue flexure of the horizontal axis. By means of a lifting lever the instrument can be quickly reversed in its standards. The cross level is suspended from near the outer ends of the horizontal axis by two sturdy hooks and can be lifted and reversed for adjustment. Thus, the cross level hanging from the horizontal axis is out of the way, permitting the telescope to be freely moved north or south of the zenith. A small circle with bubble just back of the eyepiece permits easy setting of the telescope at any desired zenith distance. Proper illumination of cross hairs is provided for night work. (*See* fig. 3.)

PROCEDURE

At the Laplace stations occupied along the arcs of triangulation the Bamberg transit was used for all observations, namely; latitude, longitude, and azimuth. Additional equipment for this purpose consisted of a radio receiver, an amplifier, and a weight-driven chronograph for recording time signals and observations on longitude stars.

The determination of the astronomic longitude was necessary to ascertain the amount of the deflection of the plumb line in the prime vertical at each station. The Laplace equation shows how the astronomic longitude enters into the azimuth determinations:

$$\alpha = \alpha' + \text{Sin } \phi(\lambda' - \lambda)$$

where,

α = true geodetic azimuth
α' = astronomic azimuth
λ = geodetic longitude
λ' = astronomic longitude
ϕ = geodetic latitude

The spheroid of reference adopted and used on the North American Continent is the Clarke spheroid of 1866. The geodetic datum now in use is the North American datum of 1927. The geodetic determinations of latitude, longitude, and azimuth at a station are referred to the geodetic zenith; and the astronomic determinations of latitude, longitude, and azimuth at the same station are referred to the astronomic zenith. The geodetic zenith is the point on the celestial sphere defined by the normal to the Clarke spheroid at the station, and the astronomic zenith is the point on the celestial sphere defined by the plumb line at the station. The deflection of the plumb line from the normal to the Clarke spheroid can be expressed by the components of the deflection along the meridian and the prime vertical. In the Laplace equation the component of the deflection of the plumb line in the prime vertical is used.

Latitude observations were made when possible for figure of earth study and were not absolutely necessary for the azimuth work.

In using the micrometer method on a circumpolar star, a reference or ground mark must be so placed as to be nearly in the vertical plane of the star at the time of observation. Fortunately, during the summer months in Alaska, Polaris was at or near eastern elongation during the night hours. The star being at elongation allowed more time for the observations before moving out of the field of view. The mark was usually set in the desired location during daylight by means of some approximately correct azimuth, such as from a reference mark of established triangulation or a meridian stake set with the Bamberg transit. At the latitudes concerned Polaris is between 1 degree 50 minutes and 2 degrees 20 minutes east of north at eastern elongation. This limited the selection of possible sites for the azimuth mark and, with the varied and rugged terrain encountered, was a problem in itself at times. Some marks were placed south of the station as the transit telescope could be easily set on marks in either direction. In all cases it was required that the mark be set at least 2 miles distant for proper pointing with an eyepiece focused at infinity. A small flashlight type of lamp was generally used on the mark during observations.

Upon setting up the field observatory the following observing program was adhered to. The Bamberg transit being placed in the local meridian within 1 second of time, the longitudes were observed first. The transits of the longitude stars were recorded graphically by electrical methods on the chronograph sheets. Radio time signals at proper intervals were also recorded on the chronograph simultaneously with the sidereal chronometer beats for the correction to the chronometer. These operations require at least two nights' work. (*See* fig. 4.)

If the azimuth mark had not been set previously this was the next operation, and all preparations made for the azimuth observations. The Bamberg instrument was shifted on the tripod head so that the image of the mark light would be centered or nearly centered in the field of view.

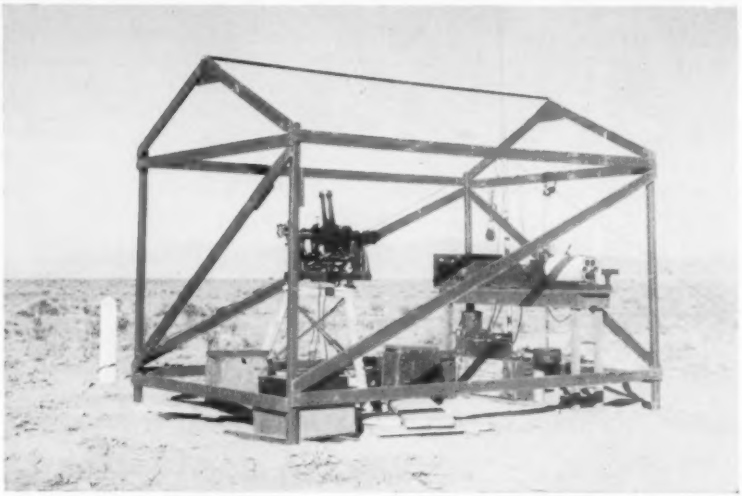

FIGURE 4.—The field observatory set up with the canvas tent removed.

The total usable range wherein small angles between the star and mark can be measured is about 30 minutes of arc. This limited the observing time from any one set position of the instrument to the time it would take Polaris to move horizontally 30 minutes. However, by observing just before and after elongation this time could be almost doubled by placing the azimuth mark some 10 to 15 minutes west of eastern elongation. Thus the mark was always set in such a position as to allow the most possible observing time, terrain and other conditions permitting. Once the mark was established and the instrument centered the actual observing was undertaken at the first opportunity.

By use of Table I of the *American Ephemeris and Nautical Almanac*, the approximate altitude can be quickly computed and used on the setting circle. When the star image appeared the bubble on the setting circle could be centered and henceforth used for subsequent pointings.

For a period of about 6 weeks during the Alaskan summer no stars are visible to the unaided eye. During this time it was necessary to set the telescope for each pointing on Polaris. With more complete darkness a star as bright as Polaris could be readily picked up in the telescope without necessarily setting for it.

The observer through experience did not wait for a perfectly clear night, as such sky conditions would be few and far between in the usual Alaskan summer. Many of the observations were taken through the edges of drifting clouds and at times through a high overhead haze.

The correction and rate of the sidereal chronometer used was obtained by eye and ear comparison with radio mean time signals as broadcast by the Navy at various hours. Comparisons were usually made just before and after the observations.

The program of observing was very similar to that followed in the usual direction method. Everything being in readiness a pointing was made on the mark

and the micrometer readings recorded. Level readings were also made if the mark light was more than 1 degree above or below the horizontal plane, through the instrument. Next a pointing was made on Polaris with the chronometer time recorded at the instant of bisection within the double movable wires. The micrometer and hanging level were read and recorded. The instrument was then reversed and the process repeated, arriving back at the mark with the eyepiece reversed from its original position. This completed one position. The next position began without changing the instrument by simply running the wires off of the mark light image and then back again to give an independent setting and reading. Under normal sky conditions about 40 positions could be observed in 3 to 3½ hours. This number of positions proved adequate in giving results whose probable errors were usually considerably smaller than the maximum allowable error of ± 0.30 second. The average probable error was ±20.21 second.

Unless unusual atmospheric or terrain conditions would appear to affect or change lateral refraction, all of the observations were taken on one night. In a number of cases, observations were interrupted by weather conditions and then the final result depended on work of two or more nights. In no case where less than eight positions were taken during any one observing period did these observations enter into the final result. The observer and recorder usually made up the observing unit, but the program was occasionally speeded up with another person reading the bubble of the hanging level. An occasional altitude reading was made on the star for the level correction computation.

One of the necessary and attendant operations in using the micrometer method is the determination in the field at each station of the equatorial value of one turn of the transit micrometer drum. This value expressed in seconds of arc is known as the equatorial factor. There are several ways to make this determination, but on this work equatorial stars (stars close to the Equator) were observed. It required that the eyepiece be at the same exact focus as used for the azimuth observations, as any change would necessarily affect the equatorial value. As the Bamberg transit must be in the local meridian for this operation, the equatorial stars were usually observed and recorded on the chronograph after the azimuth work and on the same night if possible. Changing atmospheric and temperature conditions may affect the micrometer value. About six stars were followed with the longitude micrometer across the field of view without reversal of instrument. Later these recordings were scaled and a mean equatorial value was computed.

COMPUTATIONS

The above outlined procedure when accomplished completed the field work attending the azimuth determinations. However, it was customary to make a preliminary computation in the field.

With the computation of the value of one turn of the micrometer screw derived from the observations on equatorial stars, the angle between the collimation axis and Polaris was computed in terms of arc. Likewise, the angle between the collimation axis and the mark was computed.

As the micrometer measures angles in the plane defined by the collimation axis of the telescope and the horizontal axis of the transit, these angles must be divided by the cosine of the apparent altitude of Polaris to reduce the angle to the horizon. Likewise, if the mark light was more than 1 degree above or below the horizon, the angle between the mark and the collimation axis was

TABLE 1.—*Deflections of the vertical and astronomic azimuths.*
(North American datum of 1927)

Station	Geodetic position	A–G*	(A–G) cos ϕ †	Astronomic azimuth	Probable error
	° ′ ″	″	″	° ′ ″	″
PASS ASTRO	59 37 26.635	− 1.71		181 52 00.67	±0.19
Alaska	135 08 16.234	+ 8.03	+ 4.06		
PENNINGTON	60 00 01.148	+ 1.86		181 52 25.03	±0.22
Yukon Territory	134 53 37.332	− 1.36	− 0.68		
AIRPORT ASTRO	60 41 50.263	+ 1.76		180 00 00.74	±0.24
Yukon Territory	135 03 16.617	−13.20	− 6.46		
CANYON ASTRO	60 51 35.403	− 4.04		01 17 21.60	±0.22
Yukon Territory	137 03 56.393	− 7.37	− 3.59		
BURWASH ASTRO	61 21 25.500	+ 7.69		181 19 34.46	±0.26
Yukon Territory	138 59 51.889	−18.17	− 8.71		
BEAVER CREEK ASTRO	62 27 21.763	+ 2.41		181 57 11.46	±0.24
Yukon Territory	140 51 00.293	− 1.13	− 0.52		
TANACROSS ASTRO	63 22 47.345	− 7.06		182 16 39.44	±0.25
Alaska	143 20 24.609	− 5.31	− 2.38		
RANGE ASTRO	64 49 00.888	− 1.99		182 25 08.47	±0.43
Alaska	147 38 42.707	+ 9.71	+ 4.13		
RUBY ASTRO	64 44 37.284	+ 0.60		02 15 31.63	±0.19
Alaska	155 28 08.483	+12.42	+ 5.30		
UNALAKLEET S. BASE	63 52 31.735	− 1.20		182 15 41.08	±0.18
Alaska	160 47 14.280	+17.70	+ 7.79		
KIWALIK	66 01 22.183			02 14 02.11	±0.17
Alaska	161 50 53.913	+12.34	+ 5.01		
TELLER SE. BASE	65 16 37.562			179 54 11.80	±0.20
Alaska	166 20 23.059	+18.61	+ 7.78		
CITY	64 30 03.343	− 6.15		182 23 26.97	±0.13
Alaska	165 21 25.487	+15.11	+ 6.50		
MILLER N. BASE	63 25 59.040	+ 0.55		00 56 20.76	±0.19
Alaska	145 46 36.918	+23.34	+10.44		
WILLOW CREEK S. BASE	61 50 20.546	+11.20		02 02 48.83	±0.17
Alaska	145 13 31.254	− 0.69	− 0.33		
VALDEZ N. BASE	61 07 23.334	−18.71		02 10 06.12	±0.16
Alaska	146 16 46.673	+29.17	+14.09		
SHEEP ASTRO	61 48 01.032	− 8.77		01 57 46.63	±0.21
Alaska	147 34 24.110	+24.13	+11.40		
SUMMIT ASTRO	63 22 42.933	− 7.67		02 16 46.25	±0.18
Alaska	149 00 44.599	− 1.20	− 0.54		
PETERS E. BASE	61 28 09.247			182 09 18.06	±0.21
Alaska	149 22 30.870	+52.81	+25.23		
REDOUBT ASTRO	60 29 13.786	−11.22		02 00 59.54	±0.18
Alaska	152 18 54.823	−61.18	−30.14		
LEE	57 26 11.568	−13.19		182 03 20.90	±0.13
Alaska	156 15 50.501	− 4.16	− 2.24		
STEESE W. BASE	65 33 56.13			02 14 39.19	±0.27
Alaska	145 01 19.83 (Astronomic position)				

* A–G = Astronomic minus geodetic.

† (A–G) cos ϕ = Deflection in longitude reduced to great circle arc.

reduced to the horizon by dividing the angle by the cosine of the angle of elevation or depression. Thus, for example, if the altitude was 60 degrees, the angle at the horizon would become double the converted micrometer reading. The apparent altitude of Polaris was derived by use of Table I of the *American Ephemeris and Nautical Almanac* with corrections for refraction applied.

The altitude and level corrections were made after the conversion of the micrometer readings to arc. By the proper combination of these two reduced angles for each position, which was then applied to the azimuth of the star, the astronomic azimuth of the mark was derived. The final result depended upon the mean of all acceptable positions. For the entire project about 2 percent of the observations were rejected and not used in the final result.

The azimuth mark in most cases became a supplemental station of the main triangulation scheme but was tied into the arc with a closed triangle whenever possible. In some instances the azimuth mark was a main scheme station.

The party consisted of either four or five men and camp was usually made at the station site. In a few cases this was not practicable. Travel in the Yukon Territority and Alaska was by truck, rail, plane, and river boat. In the early season at Teller, Alaska, a dog team was hired for local transportation.

CONCLUSION

Over the period of several years on this project an average of seven stations were observed during the 6 months' stay in the field. The astronomic longitudes of two stations in Canada as determined by the Geodetic Survey of Canada in former years were utilized, thus eliminating these observations from the work program. Composite results of this project are shown in table 1.

The micrometer method of observing these precise azimuths proved entirely satisfactory and the probable errors fell well within the prescribed limits. With the Bamberg transit the individual observations could be taken with great rapidity, a condition conducive to the lessening of errors arising from the instability of the instrument. At that, the wide-spread tripod held rigidly in place by plaster of paris was a firm support for the somewhat heavy instrument. A canvas tent served as cover and protection for the observatory.

The Bamberg instrument has a long horizontal axis with a long and very accurate hanging level. Small errors in inclination became important in the higher latitudes. The value of one division of the level used was 1.216 seconds of arc.

At several stations in the outer Aleutians and in the Pribilof Islands, similar observations have been made with the Bamberg transit for the establishment of independent datums. Recently the entire Aleutian chain has been brought into the North American datum of 1927.

The basic triangulation work in Alaska is not yet completed, and it is probable that in the near future other astronomic azimuths will be determined by the micrometer method to control the expanded net.

Early Land Surveying in Texas

By FORREST DANIELL
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THE ART OF SURVEYING deals with the measurements of land surfaces. Surveying is supposed by some authorities to have had its rise among the Egyptians, from the annual inundations of the river Nile in destroying and confusing all their landmarks. This act of nature caused the Egyptians to invent certain methods and measures to distinguish and re-establish the boundaries of their respective lands when the waters subsided. In ancient Egypt the primitive practice of land measurement, sufficient for the economy of the time, taxed the intelligence of the Egyptian mathematicians.

Man's curiosity and desire for adventure have caused him to wander over the earth and on the high seas. To chart his wanderings he has developed the arts of exploration and navigation, and in order to establish his domain, the art of surveying.

Although the compass was known to the Chinese 2,000 B.C., there is no evidence of its use by the Roman surveyors. About the eighth century A.D., the magnetic needle was introduced into Europe by the Arabs. Columbus and other navigators who followed him devised a method of determining approximate latitude by measuring the height of the sun at noon. This measurement was made by a cross-staff on the sea. The astrolabe was used on land, because of the motion of the ship's deck which disturbed the artificial horizon. The latitude of a position on the earth's surface was readily figured within limits, but the longitude was difficult to determine since the ship's chronometer had not been invented at that time. Although the early maps of Spanish explorations in the New World show lines of latitude, the meridional lines are omitted.

EARLY EXPLORATIONS

With the discovery of the New World, it was necessary for the Crown of Spain to obtain information concerning its new possessions. Thus it was necessary to send expeditions composed of navigators, pilots, explorers, cosmographers, military engineers, and surveyors. These men were skilled in the solution of spherical triangles, adjustment of instruments, use of the astrolabe and the cross-staff, cartography, and astronomy.

While the cosmographers were mapping the coasts of California and Texas, the explorers were inspecting the interior lands. These trained explorers reported to Spain the places suitable for settlement, such as the present city of San Antonio, Texas, founded in 1691.

Later, the Spaniards prescribed a standard procedure for the surveyors to follow in laying out streets, parceling land, and measuring it. In 1730 the surveyor at San Antonio was given detailed instructions for surveying a villa for immigrants coming from the Canary Islands. The surveyor was to arrange the bearings of the streets to be N. 45° E. and N. 45° W. The blocks were to be 240 feet square, one block for each family. To mark and preserve the boundary lines, the surveyor was instructed to plow a furrow around the limits of each block and to plant willows and other trees. He was to bury a stone exactly in

the center of each block as an additional precaution for monumenting the land. Beyond the limits of the town, the surveyor staked out certain areas for the pastures.

While the Spanish borderlands were forbidden ground to outsiders, the Crown of Spain was very generous to its favored subjects in awarding them large tracts of land. For example, on February 22, 1792, Don Jose Narciso Cavazos was issued or granted a tract of land known as the San Juan de Carricitos comprising 105½ leagues (471,624.6 acres) at an expense of only $53.62. As a prerequisite to being placed in possession of his grant, Don Cavazos, in the presence of his adjoining landowners, gave evidence of dominion by throwing water, pulling grass, and scattering it to the four winds. This land, located in the Rio Grande Valley, is noted for its soil fertility and now is covered with many extensive oil fields.

The invention in 1731 of the sextant by the American, John Hadley, and the invention of the ship's chronometer by an Englishman some years later, had a decisive influence on navigation. These improved methods soon reached the known limits of the globe. The uncertainties of points in longitude were now found by the chronometer. Skilled cosmographers made new charts and maps of the New World. Alexander Von Humboldt's exploration in the provinces of New Spain in the year 1803 resulted in a map which portrayed the relative positions of natural objects and settlements, leaving to some future time the correct fixing of the geographical positions.

In 1807 Captain Zebulon Pike of the United States Army explored New Mexico and Texas. It is said that Pike was the forerunner of the Anglo-Saxon penetration for he made many observations and took copious notes during his exploration which were reported to officials in Washington. Prior to his journey in Texas, Pike explored and mapped the Louisiana territory purchased by the United States in 1803. His astronomical instruments consisted of a sextant, an artificial horizon, and a telescope sufficiently powerful to see Jupiter's moons. At that time explorers made observations on Jupiter's moons for longitude where only approximate results were desired. Pike determined the latitude of his position by the use of the sextant and the artificial horizon. He constructed his maps by results of these observations in conjunction with the record of his days' marches.

INTRODUCTION OF COLONISTS INTO TEXAS

Since the American Indians offered an aggressive opposition to the colonial policy of Spain and later of Mexico, the authorities reasoned that if they were to hold the province of Texas, it would be necessary to invite colonists from the United States. As a result of this policy, Stephen F. Austin (later known as the "Father of Texas") and other "empresarios" brought in many colonists who were granted large tracts of land by the Mexican Government. Each family was granted 177 acres, or a labor, for farming purposes, with an additional league or 4428.4 acres if they would raise cattle.

The location of lands through the many details of surveying and the issuance of titles called for a vast amount of work. The first title to land in Texas was issued in 1731. While many large grants, totaling many millions of acres, were issued to individuals under the laws of Spain and Mexico, Stephen F. Austin was the first person authorized to settle a colony in Texas. The original concession for this colony was granted by the Spanish Government before the revolu-

tion. It was then confirmed and the quantity of land designated by the Emperor Augustin on February 18, 1823, and later confirmed by the Mexican Congress on April 10, 1823. The grants made in the name of the Mexican Government were signed by Austin as the founder of the colony and by El Baron de Bastrop as land commissioner.

Samuel M. Williams who came from Maryland in 1822 was made Secretary of Austin's Colony. Ingram, Chreisman, and other surveyors who made the original surveys would write their field notes, as taken on the ground, in English. These notes, now called "English Field Notes," were often written on small and odd pieces of paper. Since the lands were under Mexican jurisdiction, the field notes and all other official records including the context of the grants, had to be translated into Spanish. The translations were made by Williams who spoke Spanish and French as well as he spoke English. Present-day Texas surveyors are thankful that Williams preserved the original field notes, which have been bound and are now a part of the Spanish Archives of the General Land Office in Austin. It is claimed that on February 10, 1823, Horatio Chreisman made the first survey in Austin's Colony for Josiah H. Bell on the west side of the Brazos River, a few miles below La Bahia Road.

SPANISH SYSTEM OF MEASURING AND RECORDING LANDS

The Spanish system of land measure introduced into the Americas was adopted by the Mexican Government as reflected by its colonization law of January 4, 1823, which declared the "vara" to be the unit of land measure. The vara was divided into "tercios," thirds, or "pies geometricos," geometrical feet. The question among Texas surveyors is: "What is the length of a geometrical foot?" J. V. Haggard, in his *Handbook for Translators of Spanish Historical Documents*, states that a Spanish or Mexican geometrical foot is 10.936 inches. In the *Dictionary of Weights and Measures*, by J. H. Alexander of Baltimore, the Mexican vara is stated to be equal to 0.92741 of the American yard, which would be 33.38676 inches. Seth Ingram, a colonial surveyor, stated in a document dated August 18, 1825, that the "Spanish Bar (vara) contains 3 geometrical feet and the geometrical foot is 11.1333 inches in English measure." Surveyor Ingram used a chain 10 bars (varas) in length to contain 50 links, which made 5 links to the bar, each link containing 6.68 inches English measure.

The vara is now defined by Texas Statute as $33\frac{1}{3}$ inches, which gives a convenient relationship of 36 varas equal to 100 feet. It is not definitely known how the arbitrary length of $33\frac{1}{3}$ inches was assigned to the Texas vara. Some think that John P. Borden, a surveyor in Austin's colony, used the $33\frac{1}{3}$ inch vara. He was later appointed the first commissioner of the General Land Office in Texas, and he probably established that vara for the official lineal unit of measure. Present-day surveyors, in retracing original surveys in Texas, the boundaries of which are given in varas, generally assume that the original surveyors used the $33\frac{1}{3}$ inch vara. However, a number of our surveyors delight in searching the various archives to discover just what length of vara each individual colonial surveyor used in order that they might equalize their vara or the lengths of the survey lines. So it is seen that the vara in its movements and adaptations over the world has been given various values for its length.

THE COLONIAL SURVEYORS

The surveyors who came with the settlers from the East were faced with a

system of measures that most of them had not heard of before. Their measuring chains were graduated in the English system of the foot, yard, link, and perch. They did not know what conversion factor to use in relation with the vara to the foot.

The pioneer Texas surveyors were usually poorly equipped and made the surveys under conditions of hardship and frequently under actual danger. The integrity and self-sacrifice of those surveyors really command admiration. These men were mostly on foot. Many were without shoes, wearing moccasins made of deerskins which stretched when wet and, when dry, contracted to pinch their feet. Their clothing was scant. Few of them had more than one thin blanket. Their tents were mere shelters and to avoid lying in the mud, brush or grass had to be collected and matted to form a bed. The surveying party usually consisted of about a dozen men. There were the hunters who furnished the meat and the cook to prepare the meals. Among the personnel were the settlers on the land who furnished all the axemen and the chain carriers. The chuck wagon nearly always contained whisky, which seems to have been regarded as the only bit of "civilization" enjoyed by surveying parties in the wilderness.

This reminds me of the story of an old surveyor in Orange County, who in the late eighties made for posterity what are known in the land records as the "Jug Corners." At the starting point of a survey, this surveyor would give each of his men, as well as himself, a drink of whisky from a big brown jug and then would leave the jug at the beginning corner with this remark: "Now, boys, when we make this survey and return to the well-known place of beginning, we'll finish the whisky and break the jug." The writer has seen a few of those celebrated corners with pieces of a broken jug scattered around on the ground.

The "empresario" Austin received many applications from surveyors who wished to partition the lands in his colony. On April 19, 1823, Robert Andrews wrote Austin that he sought the office of surveyor for the province of Texas because he knew "all the necessities of running the surveys according to the true meridian which must be ascertained by the surveyor and of calculating the contents by latitudes and departures, the only true method." R. R. Royall wrote that he possessed the art of surveying and would like to be informed if the business was encouraged in Texas, and if the pay would be in money or in land. It seems that the only equipment that these early surveyors needed consisted of the "peep-sight" compass, the "Jacob-staff," and a chain. Some of these surveyors had trouble in calculating the variation of the compass. Settler Iams wrote as follows to Austin:

> I have seen Mr. Cook and he has the variations of the compass on the same side of the needle that I have and says Mr. Hunter is wrong. The variation is on the East or Right hand of the true North, and each line must be run on the left hand of that point of the needle which is foremost on the course. Now I am ready to give testimony and the lines will prove that Mr. Hunter has run my line on the right hand of the Needle and consequently they are wrong. . . . As proper landmarks between neighbors are of great consequence in the preservation of peace and harmony and my future exertions will probably be on this piece of ground, I would desire that my lines be run agreeable to the customary rules observed in this province.

The following quotation from a letter written by a critic of one of our early Texas surveyors illustrates the methods sometimes used:

> He runs the little compass, never using a flag but taking for a flag, objects from point

to point and as he walks to them, the chainmen follow behind him with a ten vara chain, walking around bushes as he does, zigzagging along and losing distance all the time. If wild game happens to start up near the line, the object ahead is forgotten for the time being until they get a shot and then when they go ahead, probably the same object is walked to, or one that looks very much like it.

Although there may have been some "jack-legs" who offered their services as surveyors in colonial days, the accuracy of the work suffered more from poor chaining, the extreme low value of the land, and from constant exposure to Indian warfare. Ever since the first settlement in America, the Indians had watched their country disappear before the incessant advance of the white men. Thus it was only natural that the red men had a hatred for the surveyors and for the surveyor's compass. It is said that the Comanches called the compass "The Thing That Steals the Land." Indians attacked a surveying party working a few miles east of the present city of Austin some time during August 1833. The surveyor, Christian, and a man named Strother were killed. Two men, Standifer and Haynie, made an escape to the nearby settlement. Josiah Wilbarger, a settler near Bastrop and one of the party, was terribly wounded, scalped, and left for dead. He was found late the next day by a rescuing party. Although he survived and lived until 1845, his skull, bleached as if it had been by the sun, remained bare. Strange as it may seem, there were many friendly Indians. An Indian who was given a surveyor's compass and upon having it explained to him, responded that he would keep it and use it when the stars were asleep. We find that the mere knowledge of running a compass and figuring latitudes and departures were not sufficient qualities for the early surveyors. They had to bear the privations and discomforts of a frontier settlement and possess courage and leadership among the savage Indians. The surveyor and his party were the first line of defense of the weak settlements against the Indians. George Erath, the surveyor who laid out the city of Waco and located much land in Texas, was known for his spectacular Indian fighting. He concluded his memoirs with these words:

> My eyes have now failed me altogether, my hearing is not good, but my memory of events is but slightly impaired. As in earlier times, so through my late years, I am still called upon to give information on land affairs. I am besieged with questions and through letters I cannot see to read, requesting me to study up information and to explain how land came to be located thus and so in times of different laws and different usages, for the present generation knows nothing of the difficulties that surrounded surveying forty to fifty years ago.

As we gather these surveyors of the distant past unto their fathers, let us, figuratively speaking, put a tombstone at the head of each grave and inscribe thereon:

> "He has measured much earth, but
> A small space now contains him."

A Photoelectric Planimeter

By A. J. NASH

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THE PLANIMETER plays a large part in forest inventory work, as it is necessary to determine the areas covered by various forest subtypes, particularly for the purpose of quantitative estimating.

Area measurement is carried out chiefly by means of the polar planimeter (fig. 1). The procedure is to trace the boundary of the area to be measured twice, or in some cases three times, and to average the readings. The figure obtained must then be converted to acres by applying a constant which is dependent on the setting of the planimeter arm and the scale of the map.

Mr. S. T. B. Losee, formerly of the Dominion Forest Service, conducted a series of tests in 1939 with a photoelectric light meter to determine whether any practical difference in light intensity could be detected between various timber stands as shown on air photographs. From this test came the suggestion by Mr. H. E. Seely, Chief of the Forest Air Survey Division, that the photoelectric cell be used as a device for planimetering. This suggestion was acted on by Mr. Losee, who constructed an instrument which was the prototype of the subsequent photoelectric planimeter. He continued with new developments and designs, and in 1940 an instrument which has formed the basis of this article was constructed. The period from 1941 to 1947 saw no further development owing to the war and the scarcity of supplies. Beginning early in 1947, however, the writer undertook further research in this field, and figure 2 shows the photoelectric planimeter as it is now constructed.

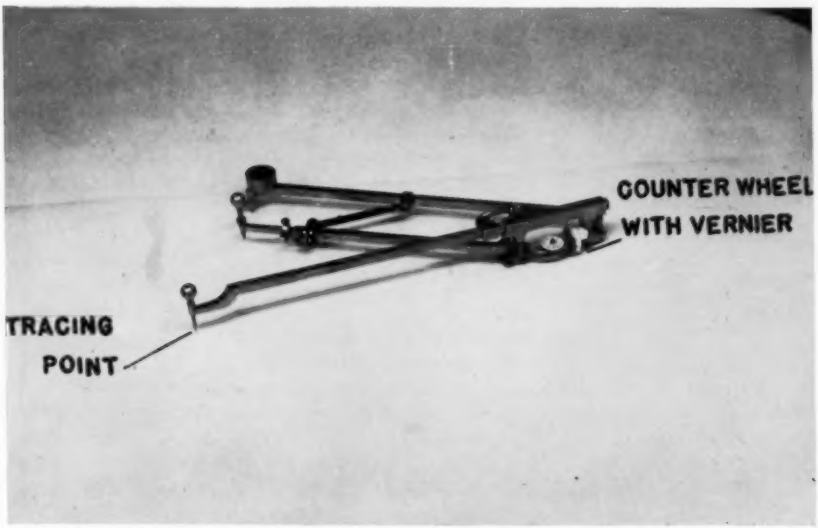

FIGURE 1.—Polar planimeter.

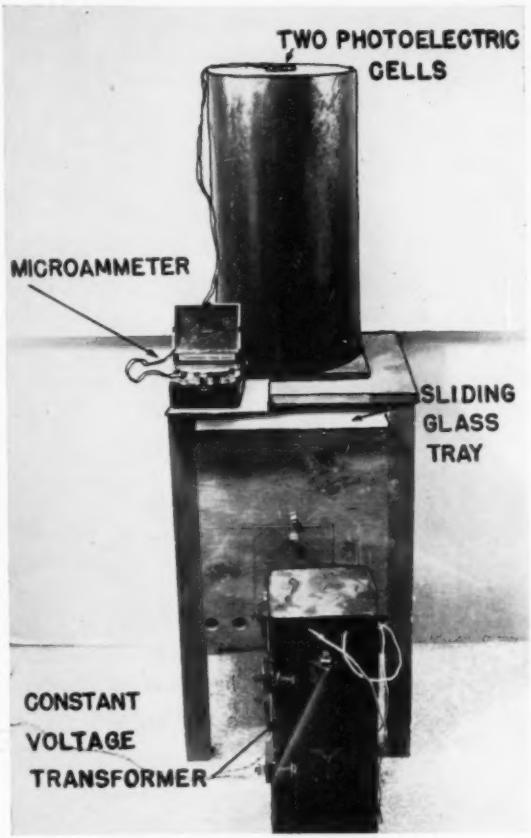

FIGURE 2.—Photoelectric planimeter.

The instrument in its present form consists of four main parts:

1. *Constant voltage regulator.*—The light source is composed of sixteen 40-watt frosted globes connected in parallel and contained in the box which appears in figure 2. To insure accuracy, this source of light must be kept at a uniform intensity. A constant voltage transformer is therefore connected between the line terminal and the light source. This transformer delivers 115 volts plus or minus 1 percent over a varying input of 95–125 volts, thus maintaining a constant supply. The speed of regulation is 1½ cycles, which, in terms of time, is 0.24 seconds.

2. *Light diffusion device.*—The light reaching the pair of photoelectric cells must be of uniform intensity and all "hot spots" must therefore be eliminated. Two sheets of flashed opal glass are inserted between the light source and the photoelectric cells. The lower piece serves both as a sliding tray on which the map segments are placed, and as a light diffusing device.

To make the diffusion of light more complete, a hollow circular column (see fig. 2), 2 feet high, is set on top of the second sheet of flashed opal glass.

3. *Photoelectric cells.*—A pair of photoelectric cells fits into a recess at the top of the column, and each of these is connected in series with the microammeter described below.

4. *Microammeter.*—A microammeter with a full-scale deflection of 50 microamperes is used to register the current developed by the photoelectric cells.

Full-scale deflection implies that all available light is reaching the cells: the scale has been reversed so that the zero reading corresponds to full-scale deflection. The instrument works on the principle of measuring the amount of light cut off by the map segment placed between the light source and the photoelectric cells. Thus, an amount of light which is proportional to the size of the segment to be measured is prevented from reaching the cells, causing the needle to read less than full-scale deflection.

The microammeter has been equipped with a special triple scale (fig. 3), which enables readings to be made in square inches, or in acres, for map scales of 10, 20, and 80 chains to 1 inch.

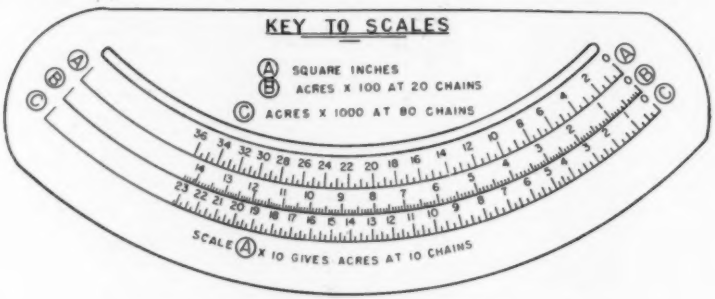

FIGURE 3.—Scale used with the photoelectric planimeter.

The map segments must be opaque to be measured in the photoelectric planimeter. It was found that the simplest method was to mount the map with rubber cement on a stiff cardboard backing. Thus the segments are stiff enough to remain flat during measurement and are easily handled at any time.

The main application of the photoelectric planimeter is in the measurement of individual areas, on each of which an estimate of timber is required. Since the segments must be measured individually, they must be cut from the map like pieces of a jig-saw puzzle. This operation is not practicable with a pair of scissors or a blade owing to the intricate pattern of the type boundaries. An electrical jig-machine (fig. 4), with the swiveling blade operating vertically, will cut eccentric patterns easily without the necessity of lifting the machine off the map (fig. 5).

COMPARISON OF RESULTS

An area of 135,239 acres on a map at a scale of 1 mile to the inch was selected as a test area to compare the speed and accuracy of the photoelectric planimeter with results from the polar planimeter. The boundaries of the areas were traced three times with the polar planimeter, providing a less favorable comparison in time consumed than if traced twice only. It may be explained that the third tracing provides an additional check. A comparison of the results is given below:

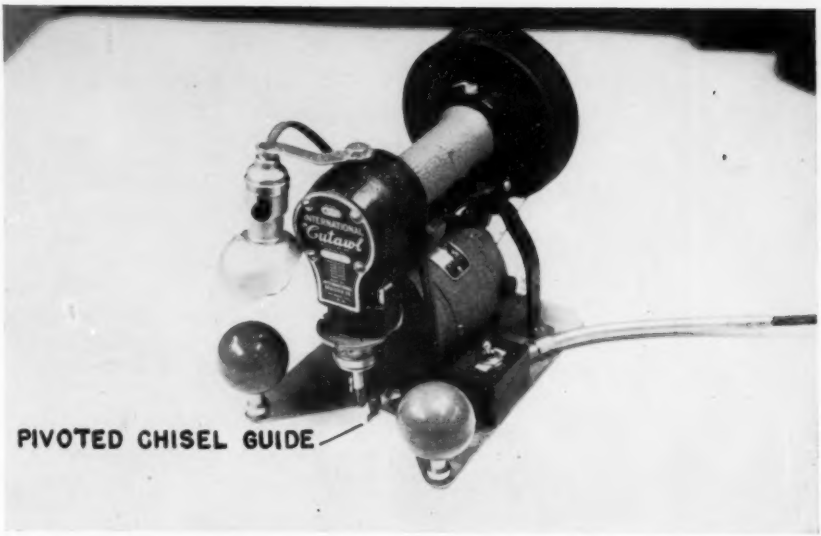

FIGURE 4.—Jig-machine used to cut out segments from the prepared map.

FIGURE 5.—Segments of the prepared map.

FIGURE 6.—One segment on tray. To obtain the area of the segment the tray is pushed in and the area is read directly from the scale.

1. Time required:	
By polar planimeter (includes compilation)	23 hours
By photoelectric planimeter (includes preparation of the map, cutting the segments, planimetering, and checking)	5 hours
Time saved	18 hours
2. Comparison of acreages:	
Total acreage of list area from map dimensions	135,239 acres
Sum of acreages by polar planimeter	136,785 acres
Difference	+1,546 acres
Sum of acreages by photoelectric planimeter	132,389 acres
Difference	−2,850 acres
3. Percentage difference:	
By polar planimeter	+1.14 percent
By photoelectric planimeter	−2.11 percent

NOTE: Subsequent investigations showed that the cutter blade is responsbile for a kerf amounting to approximately 1 percent of the total area.

It is obvious from the above comparison that the great advantage of the photoelectric planimeter is in the saving of time. It enabled the test to be carried out in 5 hours as compared to 23 hours by the polar planimeter.

The map segments are, of course, already marked with symbols which identify their classification. The number of acres is added to each and the segments become a tangible record which facilitates compilation and checking. This is a distinct advantage of the photoelectric planimeter.

The microammeter of the photoelectric planimeter may be read with greater ease than the vernier graduations on the wheel of the polar planimeter. Furthermore, in the case of the former instrument, the readings are made directly without recourse to a converting factor.

The tedious nature of the work done with the polar planimeter is a drawback and tends to produce errors.

The photoelectric planimeter was calibrated by means of squares of unit size and the fact that constant readings were obtained with the calibration squares indicated that sufficiently accurate results are obtainable.

The polar planimeter and the photoelectric planimeter apply fully in the case of the measurement of individual areas, which is often required when an accurate estimate of timber quantities is needed for a limited number of square miles. When, however, it is merely necessary to determine aggregate areas and estimates for whole map sheets, the dot grid becomes a very useful device. This consists of a number of regularly spaced dots marked on a piece of transparent material. When this is superimposed on the map the number of dots which fall on each area may be counted and the acreage may be determined by multiplying by the number of acres represented by each dot. The scale of the map determines the value of each dot. If speed of operation is required the dots may be widely spaced, but accuracy is then affected. This is particularly true in reference to small areas, such as little lakes, muskegs, and isolated patches of timber. Further difficulties arise when a dot falls directly on a boundary line. For the measurement of individual areas the photoelectric planimeter provides a greater degree of accuracy than the usual dot grid.

The Use of Aerial Photography in Property Surveys

By ROBERT E. FRIERSON*

EDITOR'S NOTE.—The following discussion of the use of aerial photographs in property surveying, while essentially descriptive of the methods used by the TVA on surveys of large areas, is also applicable, with minor modifications, to individual tract surveys. Suitable aerial photographs for most of the United States are now available through the U. S. Department of Agriculture. (See p. 79 of January-March 1946 issue of SURVEYING AND MAPPING.)

INTRODUCTION

AERIAL PHOTOGRAPHY as a tool in surveying and mapping has enjoyed most of its development in the last 10 to 15 years. Since its establishment some 13 years ago, the Maps and Surveys Division of the Tennessee Valley Authority has maintained a keen interest in these developments, and has utilized aerial photographs in most of its surveying and mapping activities. The Division has pioneered many of the developments and procedures that have contributed to the place aerial photography holds today in the field of surveying and mapping.

Although aerial photography is used extensively in the mapping programs of the Authority, this paper is confined chiefly to the applications adapted to property surveys.

Shortly after its creation, the Tennessee Valley Authority was faced with a very large property survey job on its initial project, the Norris Reservoir. It was obvious that a small army of surveyors would be required to maintain established schedules if conventional transit-tape survey methods were to be used. Aerial photographs were made of the Norris Reservoir area and after a few experiments, procedures and methods for their use in making property surveys began to develop rapidly. Although those early methods have been revised in many respects to employ later developments and short cuts, the application of the fundamental principle—the use of aerial photographs in property surveys—has continued through 18 additional reservoir projects.

The Authority's use of aerial photography in property surveys has been employed on what might be termed a wholesale basis since it has involved relatively large areas. Consequently, for single property surveys or for property surveys covering a relatively small area, certain of the procedures are not applicable. However, most of those described below can readily be adapted to the surveying of single properties or small groups of properties. Methods employing the use of rather expensive stereophotogrammetric equipment now used by the Authority have purposely been omitted as inapplicable except for large-scale undertakings.

Based on a paper presented at the Short Course in Surveying and Mapping, Georgia School of Technology, March 1947.

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PROCEDURE

Although revised from time to time to take advantage of new developments or to fit special cases, the basic procedure employed by the Authority in the use of aerial photographs on property surveys may be briefly summarized as follows:

1. *Aerial photographs.*—Contracts are let for the aerial photography and flight lines are laid out so as to obtain photographs best adapted to the survey job.
2. *Reconnaissance ownership map.*—Obtainable deeds to properties within the area to be surveyed are copied, and small-scale ownership maps showing the general outlines of the tracts are prepared for planning, work scheduling, deed indexing, and for later use by property survey parties for orientation and reference.
3. *Ground control.*—Horizontal and vertical control stations are established throughout the area for maintaining geographic position in mapping and for providing convenient bench marks for leveling, contouring, etc.
4. *Scale checking photographs.*—The photographs are scale-checked and ratioed for controlling accurate enlargement.
5. *Property surveys on photographs.*—On photographs, which have been enlarged to the proposed map scale (usually 1 inch equals 500 feet), property corners and boundaries are identified in the field, using the photograph as a planetable sheet.
6. *Control rolls.*—A control roll is prepared on which the correct horizontal positions of selected identifiable photographic points are plotted and to which property lines and corners previously located on the photographs are compiled by radial line intersection for removal of relief displacement.
7. *Land maps.*—In preparing the final land map, property boundaries are traced from the control roll and planimetry is traced directly from the photographs.

As is the case with most established procedures, some variation is usually required when applied to a particular project. The brief explanation of the above steps which follows gives a rather complete picture of the basic methods which have been used successfully in the large-scale property surveying programs of the Authority.

Contracting for Aerial Photographs

Most of the aerial photography for property mapping was obtained under contract arrangements with aerial photographic companies. Such contracts specified the forward and side overlap required, and tolerances for tilt, flying height, and other predetermined requirements. Flight maps provided for the guidance of the contractors, were prepared from a regional map of the area on which the individual flight lines were laid out, usually in colored pencil. Flight lines were usually north and south. As the reservoirs were generally in an east and a west direction, relatively short flight lines crossed back and forth across the reservoir. Since basic traverse was located, in general, along each side of the reservoir, the flight lines were crossed near the ends by the traverse lines and each flight could readily be controlled. Most of the flying was designed to give 60 percent overlap along the line of flight and 40 percent side overlap. Flying heights were selected so that a contact print at an approximate scale of 1 inch equals 1,250 feet would be obtained. This permitted enlargement with little loss of detail to a scale of 1 inch equals 500 feet—the predetermined scale for property surveys. Prior to acceptance all pictures were inspected for compliance with specifications as to quality.

Preparation of Reconnaissance Ownership Map

As soon as aerial photographs of the reservoir area were available, reconnaissance ownership mapping was started. The reconnaissance ownership map was prepared by using the best available map of the region as a base, plotting thereon the approximate locations of the ownership lines, and identifying each tract with the owner's name and a deed reference number. These maps, intended primarily for the use of the property surveyors in their detailed surveys work, were also used extensively for planning and scheduling not only the survey work but also the mapping, appraisal, title examination, and the purchase programs.

With copies of the contact photographs and a copy of the existing map of the area (a scale of 1 inch equals 2,000 feet proved convenient for this purpose) on which the approximate limit of the proposed reservoir had been projected, the surveyor would go to the field and plot on the photograph, by identification on the ground, the property boundaries of the individual owners. Then, the property ownership lines were transferred to a transparent reproduction of the base map by tracing, shifting the photographs as necessary to match identifiable features already shown on the existing map.

Establishing Ground Control

Before or along with the photographic and reconnaissance work, basic control traverse was run in the reservoir area in order that the proper geographic positions of mapped features could be obtained by means of the procedures which were to follow. The traverse, usually of third-order accuracy, was designed to run in general along the outside edge of the main reservoir with side loops to tie-in the various embayments and sufficient cross-ties to provide proper closures. For convenience of the survey work the traverse was, where possible, run along roads. In order that the intervening picture in each flight could be controlled by graphic triangulation or so-called bridging it was desirable that the traverse cross near the ends of the individual flight lines previously described. In many instances, where the flight lines were quite long, that is, more than 8 or 10 pictures, additional control would be required. In establishing this control, more or less permanent markers were set at an average interval of 1 mile with many semi-permanent intermediate markers every 1,500 to 2,000 feet.

Scale-Checking Photographs

In order to determine accurately the scale of the individual photographs, every fourth or fifth picture along each line of flight, or along every other flight line, was scale-checked. Usually this was accomplished by tying in three or more identifiable points (points on the ground, clearly distinguishable on the photograph) to the horizontal control markers near the end of the flight line by supplementary traverse. This also provided the ties to identifiable photographic points for the control of mapping. Approximate elevations (within 10 feet to 20 feet) were obtained at each point, usually by barometer, and the position of the points adjusted for elevation displacement as explained later. The true distance along each line was computed and compared with the scaled distance to find the scale of each photograph. Scales of the intermediate photographs were determined by interpolation. When ground control stations were not

conveniently located, points were selected on the ground which were clearly identifiable on the photograph and distances between them determined by direct measurement or connecting traverse. The relationship of the measured distances to those scaled on the photograph was the scale of that picture. Accurate scaling of the contact prints permitted enlargement to the desired scale—in this instance 1 inch equals 500 feet. In making the property surveys the enlargements were used in the field as planetable sheets.

Property Surveys on Enlarged Photographs

1. *Characteristics of photographs.*—In using aerial photographs for survey work, it is necessary that their limitations be clearly understood. Difficulties arising from tilt or tip distortion are usually disposed of by requiring reflight of any pictures containing excess tilt or tip as provided for in flight specifications. Distortion from relief displacement, however, must be computed or allowed for in using photographs for survey work. Relief displacement of any picture point is *always* along a radial line from the center of the photograph to the image and increases with its distance from the center toward the edge. In flat terrain no relief displacement is encountered while in mountainous terrain rather large corrections are required to transfer photographic positions to their corresponding map positions. Points higher than the established datum plane (the proposed lake level in TVA work) must be moved along a radial line toward the center of the photograph; conversely, points lower than the established datum plane must be moved along a radial line away from the center of the photograph to establish true map position. The amount of movement is derived from a simple relationship and equals the height of the point above or below datum divided by the flying height above datum multiplied by the distance of the point from the center of the photograph.

Since the effect of relief displacement diminishes toward the center of the photograph and the photography had some 60 percent overlap along the line of flight and 40 percent side overlap, the working area on any photograph was confined to approximately the middle one-third. The working limit was usually marked on each photograph in the office before sending it to the field for survey work.

2. *Identifying positions on the photos.*—For making property surveys the field man was equipped with a planetable outfit, a copy of the property reconnaissance ownership map showing the approximate size and name of each ownership, the contact prints of the aerial photographs on which the reconnaissance ownership information was shown, and the ratioed enlarged photographs on a scale of 1 inch equals 500 feet. The owner was contacted to verify the locations of his property lines, specific inquiry being made regarding any additional information concerning lost or unidentifiable corners which may come to his attention since the reconnaissance ownership man visited the property. All property lines readily identifiable on the photographs, such as fence rows, roads, creeks, etc., were immediately marked on the photograph. Next, all corners near readily identifiable points were plotted by short tape measurements or stadia shots. Other points which could not be readily identified were located by planetable traverse, using the enlarged photograph as a planetable sheet or using a conventional white paper sheet. After all corners had been identified, and the connecting lines drawn in, the property surveyor identified

and outlined with colored pencils woods lines, roads, buildings, wells, orchards, springs, and other items of value which would be given consideration in appraising the property. Most of this information was indicated directly on the photographs by the use of symbols, abbreviations, and abbreviated notes.

Corners unidentified on the photographs and located by planetable traverse were for consistency converted to photographic positions by moving them toward the center or away from the center along radial lines, depending on their elevation with respect to the datum plane established for the photography. Quite often the planetable traverse for locating unidentifiable corners was made on white paper, rather than directly on the photograph, and cross-referenced to the photograph. This was done in order to avoid cluttering up the photograph and to avoid the necessity of converting to photographic position, since the corners would be transferred later directly to the control roll.

In sectionized country the photographs proved exceptionally useful in reestablishing section corners and quarter section corners which would have required many miles of traverse and survey work. Evidence of section lines for several miles in each direction from the corner could be identified on the photographs and by projecting these lines and parts of lines to intersections, or in some cases by scaling on the photograph, the approximate location of the section corner could be determined. Scaling from a close identifiable point to this theoretical position confined the area of search to narrow limits and quite often placed the surveyor within a few feet of the position of the corner, thus resulting in the recovery of corners which were reputedly destroyed or had been lost for many years.

3. *Small or odd-shaped tracts.*—In that the bearings, distances, and acreages of the tracts delineated on aerial photographs will later be scaled from the control rolls or maps, the shape and the size of the property is particularly significant. Larger percentages of errors naturally develop in smaller tracts than in larger ones; also long narrow tracts are subject to larger percentage of error than those approaching squares. Consequently, it was the practice to tape on the ground any sides of a tract which were less than 500 feet, and to survey by usual planetable methods on white paper, at a scale of 1 inch equals 200 feet, any tract of less than 10 acres. Transit traverse and planetable surveys were also employed where the reservoir encroached on urban communities and subdivisions, and where small individual lots were encountered.

Control Rolls

In obtaining positional accuracy on the final map for the tract boundaries as represented on the photograph, a transfer medium commonly called a control roll was employed. The roll consisted of high-grade tracing cloth with a small coefficient of expansion and was usually 42 inches wide and 12 feet to 14 feet long, the width being sufficient to accommodate the information contained on three adjacent flights. Horizontal control stations, usually located near each end of the flight or about 8 to 10 pictures apart on long flight lines, were carefully plotted by plane rectangular coordinates. Consecutive photographs along the lines of flight were then positioned by means of graphic triangulation between the bands of ground-controlled points at each end of the flights, all three flights covered by the control roll being carried forward simultaneously. The purpose

of this procedure was to locate in their true position on the control roll the center and orientation of each photograph. The graphic triangulation, or bridging between plotted control, is a simple mechanical means of fitting the photographs into their proper positions, eliminating the error which would otherwise accumulate if images on overlapping photographs were merely matched. First, "rays" (or radial lines) were drawn from the photo centers to nine or more image points selected around the sides of each photograph, so that the overlaps would cause each point to be identifiable on three pictures as well as to any control points that might fall on the photograph. The pictures on which the control traverse stations were located were then fitted under the control roll so that all "ray" lines on the photographs passed through the corresponding control points plotted on the control roll. While fitted in this position, the centers of the photographs were marked on the control roll. Next the adjacent photographs were placed under the control roll tracing and positioned by matching features in a similar manner. This process was continued along the roll until the previously plotted field-located control points at the other end of the flight were tied in. Closing errors were then adjusted back through the line of flight, by working backward from the end control.

Upon completion of the steps just described, the enlarged photographs were refitted to the control rolls and "rays" drawn to each property corner from each picture on which the property corner could be identified. The location of each property corner was, therefore, determined by three or more "rays" intersecting at a common point or at almost a common point. The result was a skeleton outline of the properties showing the corners in their correct coordinate positions, the use of radial line intersection having removed mechanically the distortion in the photograph due to the relief displacement. Occasionally, certain additional features, such as identifiable points along roads in areas of rugged relief, were rayed-in so that their true alignment could be represented on the finished map.

The property corners were then connected up and bearings and distances scaled directly on the control roll. The acreage of each tract was also planimetered on the control roll where the scale was likely to be most accurate.

Land Maps

The finished land maps were planned to cover the entire reservoir area with individual tracing cloth sheets 33 by 46 inches or 22 by 34 inches. These sheets with the coordinate grid lines laid out, were oriented over the control roll by matching grid lines—all property corners and lines, control points, picture centers and other points previously rayed-in were then traced. Next the land maps were fitted over the individual photographs and all the remaining map detail traced directly from the pictures, shifting as often as necessary to obtain the best fit with the nearest control or property points. The final map shows, in addition to the property lines, their scaled bearings and lengths, the acreage of each tract, roads, trails, wooded areas, orchards, houses, and other classified buildings, power and telephone lines, and other features which might be given consideration in the appraisal or which might prove helpful to the layman in orientation on the ground.

EXTENT OF PROPERTY MAPPING PROGRAM

In the last 13 years, the Division has surveyed and mapped property on 19 reservoirs. In all, the surveys cover more than 2,000,000 acres of land divided into some 32,000 tracts, ranging in size from a fraction of an acre to 2,000 acres but averaging about 60 acres per tract. This is not the total acreage purchased for the 19 reservoir projects, it being obviously necessary to survey and map considerably beyond the limits of the area to be acquired. Our experience indicates that about twice as much land must be surveyed and mapped as will be purchased.

CONCLUSION

As previously explained, some of the methods set forth in this paper are no longer employed in the Authority in its property mapping program. Stereophotogrammetric equipment, large copying cameras, and vertical overhead projectors, which are now used in connection with other mapping work, eliminate certain of the steps and permit other short cuts. On the early projects, however, this equipment was not available, and the methods and procedures developed then for use of aerial photography on property and miscellaneous surveys were selected for presentation since they can be readily adopted for general use at a nominal cost merely for the obtaining of ratioed aerial photographs from the AAA. Index maps showing the availability of AAA photography indicate that coverage is nearly complete for the entire country, the only remaining gaps comprising some areas in the southeast part of the country.

The value of aerial photography in surveying and mapping for large developmental programs has definitely been proven and there seems ample justification for predicting its wider use in limited areas as soon as surveyors become more familiar with its possibilities.

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New Maps Being Made for West Virginia

WEST VIRGINIA is embarking on a 5-year program of reinventorying and remapping all 33,000 miles of roads in that state, with the first maps scheduled for completion by the State Road Commission some time this summer.

When completed, the new set of maps—one for each of the 55 counties in the state—will replace the state's existing county maps which were traced in 1937 from U. S. Geological Surveys.

The new maps are being prepared from aerial mosaics made especially for the state by the U. S. Department of Agriculture. Mosaics first are interpreted at a scale of 2 inches equals 1 mile, onto transparent plastic sheets, showing all roads, streams, and railroads.

A base tracing is made on linen from each plastic tracing. Field parties, traveling by cars equipped with accurate speedometers and by walking roads impassable by car, make a complete inventory of all items of "culture," such as houses, farms, churches, etc.

This culture is tranferred to the base tracings, denoted by various symbols. Route numbers and types of surface, both improved and unimproved, also are shown for all roads. All printing on the maps is by the "stick-up" process, using various types for the different features. Final step is to lithograph each map, in black and white, to a scale of 1 inch equals 1 mile.—*Engineering News-Record*, April 15, 1948.

Plane Triangles Solved by Calculating Machine

By R. M. WILSON

CHIEF, GEODESY AND CONTROL SURVEYS, U. S. GEOLOGICAL SURVEY

ALMOST from the time of their discovery, logarithms have been used universally in the computations of plane and geodetic surveying. Textbooks and instruction manuals, based upon past practice, constitute a ponderous momentum that is carrying the use of logarithms forward into an age of calculating machines. Nevertheless, these modern machines, used with natural trigonometric functions, are properly becoming very important in surveying computations. Perhaps they are even paving the way toward electronic computers for the surveyor because mechanical counter dials and vacuum-tube electronic counters are surprisingly analogous in their operation. Certainly it is high time for textbooks on surveying and practical trigonometry to break away from the exclusive habit of logarithms, and at least be bold enough to mention machine methods.

Calculating machines are definitely established in many phases of surveying work. They are now generally used to solve adjustments by the method of least squares. Since about 1935 the U. S. Geological Survey has been using machines, and natural sines and cosines, to compute latitudes and departures for several thousand linear miles of transit traverse each year. Two methods have been published showing how to use machines instead of logarithms for computing geodetic coordinates through triangulation systems; one of these described in a paper by the U. S. Coast and Geodetic Survey[1] uses the meter as the unit of length, and the other, which was originated in the Geological Survey, uses feet instead of meters.[2] The use of machines to convert coordinates from geodetic to plane and vice versa in the State Plane Coordinate Systems is also established practice.[3] Many other surveying computations that have been adapted to calculating machines might be cited.

Strangely enough a machine technique for solving ordinary plane triangles has not been given much attention. Textbooks on trigonometry invariably offer formulas devised particularly for use with logarithms of functions and numbers. As noted above, other phases of computing in traverse and triangulation surveys have been mechanized, so why not gear the solution of triangles into the same tempo? Perhaps the computer may soon be able to forget his logarithms! Good

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Publication of this article has been approved by the Director, U. S. Geological Survey.

[1] SIMMONS, L. G. and ADAMS, OSCAR S.: Geographic Positions by Machine Computation, Paper G-43, *U. S. Coast and Geodetic Survey,* 1944, Washington 25, D. C.

[2] WILSON, R. M. and HESS, IRENE: Machine Computation of Geodetic Position, *Photogrammetric Engineering,* Vol. XI, No. 1, p. 30.

[3] SPEERT, J. L.: Formulas and Tables for the Transformation of Geodetic to Plane Coordinates on the Lambert and Transverse Mercator Projections (special leaflet), *U. S. Geological Survey,* 1943, Washington 25, D. C.

tables of natural trigonometric functions are now available for even the most precise work.[4, 5]

Extensive geodetic triangulation actually is composed of systems of spheroidal triangles solved individually by using representative plane triangles. Accordingly, the methods offered here are applicable to such surveys as well as to the problems of plane surveying.

In all textbooks on trigonometry there are several cases into which solutions are classified depending upon which three independent parts of the triangle are given. They may be defined as follows:

Case I. Given one side and any two angles.
Case II. Given two sides and an angle opposite one of them.
Case III. Given two sides and the included angle.
Case IV. Given three sides.

The computing form described here is suitable for all four cases. Cases I and II, which depend upon the law of sines alone, use only three lines of the form. Each of these lines has space for an angle, its sine, and the length of the opposite side. Cases III and IV require additional space, but the first three lines still have the same arrangement as for Cases I and II. Solved triangles, therefore, will always have their six parts presented in a *standard arrangement*, no matter what their case classification may be. Furthermore, this arrangement is such that the established forms for triangle computation now in use by the Geological Survey and the Coast and Geodetic Survey (Forms 9-901 and 25, respectively) can be used with only minor modification of column headings.

Figure 1 shows the general arrangement used in all cases, A, B, and C representing the three angles, and a, b, and c, respectively denoting the lengths of the sides opposite them.

Assuming that sines for angles, and angles for sines, in the three main lines of the form have been correctly found in the tables and written into the form without error, the rest of the computation is checked by verifying these two conditions:

Ratio D must be the same in all three lines.
Sum of the angles A, B, and C must be 180°.

	D = Ratio; side ÷ sine	
A	sin A	a
B	sin B	b
C	sin C	c
This line used in cases III and IV		
This line used in case IV		

FIGURE 1.—Skeleton diagram used in all cases.

[4] "Natural Sines and Cosines to Eight Decimal Places," Special Publication No. 231, *U. S. Coast and Geodetic Survey*, 1942, Washington 25, D. C.

[5] IVES, HOWARD CHAPIN: Natural Trigonometric Functions (7 places and 10-second interval), *John Wiley & Sons*, New York.

CASE I

4) $D = a \div \sin A$

(A)	given	1) find sin A		(a)	given
(B)	given	2) find sin B		5) $D \times \sin B = b$	
C	concluded	3) find sin C		6) $D \times \sin C = c$	

				41 980.1527	
*	48 00 09.86		.743 17681	*	31 198.676
*	61 27 31.29		.878 47287		36 878.425
	70 32 18.85		.942 86599		39 581.658

FIGURE 2.—Solution for one side and two angles (Case I).

CASE II

2) $D = a \div \sin A$

(A)	given	1) find sin A		(a)	given
4) find B from its sine		3) $b \div D = \sin B$		(b)	given
5) $180 - [A+B] = C$		6) find sin C		7) $D \times \sin C = c$	

				48 118.1570	
*	31 20 13.32		.520 07129	*	25 024.872
	71 51 47.10		.950 31536	*	45 727.424
	76 47 59.58		.973 57844		46 846.800
				48 118.1570	
*	31 20 13.32		.520 07129	*	25 024.872
	108 08 12.90		.950 31536	*	45 727.424
	40 31 33.78		.649 79371		31 266.876

FIGURE 3.—Solution for two sides and angle opposite one of them (Case II).

For each of the four cases a key diagram is presented as a guide for computing. Symbols for the three given parts are encircled while reference numbers show the sequence of the steps required to complete the solution. In the numerical examples following the diagrams, the known parts are indicated by asterisks.

The examples are fitted into sections of Form 9-901. For geodetic triangulation, the computer may prefer first to write down the full spherical angles and then to enter the seconds of the corresponding plane angles in the narrow column that is left open in the examples given.

Case I: Given one side and any two angles.

This is the simplest case, and includes most of the triangle solutions required in triangulation surveys. (Fig. 2.) Obviously, when two angles are given, the third can be "concluded" to make the sum of all three equal 180°. The concluded angle may be any one of the three. When D has been found and set in the machine as a multiplier, it is applied in succession to sin A, sin B, and sin C to check on a, and to determine b and c.

Case II: Given two sides and an angle opposite one of them.

In this case there are sometimes two possible solutions (fig. 3), because two

CASE III

		9) $D = a \div \sin A$
5) find A from $\tan A$	6) find $\sin A$	(a) given
(B) given	1) find $\sin B$	10) $D \times \sin B = b$
7) $180 - A - B = C$	8) find $\sin C$, and ck on c	(C) given
4) $a \sin B \div (3) = \tan A$	2) find $\cos B$	3) $c - a \cos B$

			41 466.3651
* 61 38 08.66		.87994508	* 36 488.124
* 28 28 02.12		.47665644	19 765.210
89 53 49.22		.99999838	* 41 466.298
+ 1.85222185		+ .87908966	9 389.9655
			67 142.6429
* 20 42 55.60		.35372699	* 23 750.165
* 112 17 48.55		.92523078	62 122.440
46 59 15.85		.73120771	* 49 095.217
.37817660		.37940480	58 106.144

FIGURE 4.—Solution for two sides and included angle (Case III).

CASE IV

		8) $D = a \div \sin A$
6) find A from (5)	7) find $\sin A$	(a) given
11) find B from (9)	9) $b \div D = \sin B$	(b) given
12) find C from (10)	10) $c \div D = \sin C$	(c) given
4) (3) x (2) ÷ (1)	3) (2 s x .5) - a	2) $2s = a+b+c$
5) cos A = (4) - 1		1) bc

40 498.1605

77 47 14.51	.97736928	.39581.658
38 09 53.45	.61792614	x25 024.872
64 02 52.04	.89915936	x36 414.300
1.21154031	.10928757	1x01 020.830
.21154021		x09 112.632

FIGURE 5.—Solution for three given sides.

different angles are indicated by the value obtained for sin B. One of these angles will be less than 90°, and the other is its supplement, in the second quadrant. However, when this is possible in practical application, there seldom will be any doubt as to which triangle to use.

Following the key diagram there are shown two numerical solutions both of which satisfy the same given elements.

Case III: Given two sides and the included angle.

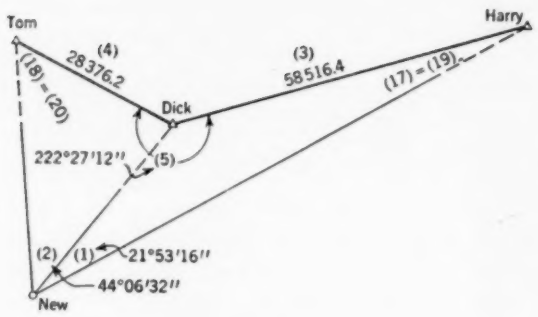
The first of the unknown angles will be found through its tangent (fig. 4). So it is good practice (though it is not necessary) to solve for the angle opposite the shorter given side, which will be in the first quadrant and not too near 90°. The formula used is:

$$\text{Tan } A = \frac{a \sin B}{c - a \cos B}$$

Care must be taken with the algebraic signs, because cos B will be negative if B is greater than 90°, and then the denominator in the formula will be numerically greater than c.

Case IV: Given three sides.

The first angle determined will be A, on the upper line of the form. (Fig. 5.) Since it will be found from its cosine, a very small angle should not be sought in this place. Accordingly, if one of the three given sides is very much shorter than the other two, it should not occupy the upper space as a.



KEY, using symbols only

AT STA:

New (1) Observed	(8) = sin 1	(12) = 3 ÷ 8	(3) Given
Dick (21) = 180° − 1 − 19	(23) = sin 21		(27) = 12 x 23
Harry (19) = 17	(24) = sin 19		(28) = 12 x 24
New (2) Observed	(9) = sin 2	(13) = 4 ÷ 9	(4) Given
Tom (20) = 18	(25) = sin 20		(29) = 13 x 25
Dick (22) = 180° − 2 − 20	(26) = sin 22		(30) = 13 x 26
Dick (5) Given			
(6) = 1 + 2 + 5			(14) = 12 ÷ 13
(7) = 360° − 6	(10) = sin 7		(11) = cos 7
Harry (17) = $\tan^{-1}$ 16	(16) = 10 ÷ 15		(15) = 11 + 14
Tom (18) = 7 − 17			

Specimen Computation

				156 968.8
New	21°	53'	16"	.372790	58 516.4
Dick	145	17	12	.569471	89 389.2
Harry	12	49	32	.221983	34 844.4 ✓
				40 769.0	
New	44	06	32	.696024	28 376.2
Tom	58	43	28	.854680	34 844.4 ✓
Dick	77	10	00	.975020	39 750.6
Dick	222	27	12		
	288	27	00		+3.850200
	71	33	00	+.948600	+ .316477
Harry	12	49	32	+.227663	+4.166677
Tom	58	43	28		

FIGURE 6.—Machine computation of three-point problem.

The formula used is as follows:

$$\text{Cos } A = \frac{2s\,(s-a)}{b\,c} - 1$$

in which $2s = (a+b+c)$.

To follow the decimal point easily in steps (1), (2), (3), and (4), the points in a, b, and c may all be shifted an equal number of places to convert these distances into proportionate values near unity. This is permissible because it does not change the shape of the triangle nor the size of its angles. Do not forget to subtract 1 as shown in step (5). If the result (which is cos A) is positive, A is less than 90°; if negative, of course A must be in the second quadrant and be more than 90°. If A is less than 90°, either B or C possibly may be in the second quadrant. However, it cannot be the one opposite the shorter side, so determine this smaller angle before the other, and add it to A. If the sum is less than 90°, it is obvious that the remaining angle, opposite the longer side, must be more than 90°, and in the second quadrant.

THE THREE-POINT PROBLEM

A convenient solution for the three-point problem, using an arrangement consistent with the triangle solutions just described, was published in *Civil Engineering* (Vol. 16, No. 2, Feb. 1946, p. 72). The example, along with a part of the description, is repeated here because this method is used frequently in computing triangulation. (*See* fig. 6.) It is divided into three sections: the first two are for the triangles involved; and the third is for the additional computation required in this particular problem. The triangles have a side in common, which is the line from the three-point station NEW to the point common to the two bases. Each triangle has two known parts—the base and the opposite angle at NEW. In addition, the angle between the bases is known. This angle (5) must be the one through and including the triangles, even if it is more than 180°. If the new station is close to the circle passing through the three base points, the solution becomes weak. The solution is indefinite when (6) = 180°. In the third part of the computation, particular care must be exercised to use the correct sign for cos (7) so that (15) will be the true algebraic sum and so that (17) may be taken in the proper quadrant, according to the sign of its tangent.

Finally, the sides (27), (28), (29), and (30) are found on the same lines with the angles that are opposite to them in their respective triangles and, of course, (28) and (29) should check.

A Surveying Problem

By J. HAROLD HOLMQUIST
ILLINOIS LAND SURVEYOR

IN ORDER to properly understand the various phases of the problem I am about to present, it will be necessary to study the accompanying illustration which shows a lot in a subdivision that I was called upon to check. The survey was made by another surveyor. He surveyed Lot 2 and set the $\frac{5}{8}$-inch iron pins, as shown, by prorating the entire block. One can plainly see that, as he surveyed it, the garages extend over Lot 2, while the house on part of Lot 1 also extends over the line. This is a case where, in my opinion, one cannot prorate. The appurtenances have been on the ground well over 30 years.

The easterly 35 feet of Lot 1 is in one piece, while the remainder of the lot is divided into two portions, North and South. The description of South, as shown in the deed, indicates a distance of 37.50 feet along the west line, beginning at the southwest corner, and then easterly to a point that is 35 feet from the east lot-line and 36.50 feet north of the south lot-line. The description from this point continues, "then south, parallel with the east line of Lot 1, 36.50 to the south line of Lot 1, then west along the south line of Lot 1 to the west line of Lot 1."

I feel sure that the error which has resulted comes from the location of B Street at the time of the original survey. I spent a large amount of time convincing myself of this by studying survey records and notes of previous field work. To state all the facts here would involve too much description so I will simply touch upon some of the most important points.

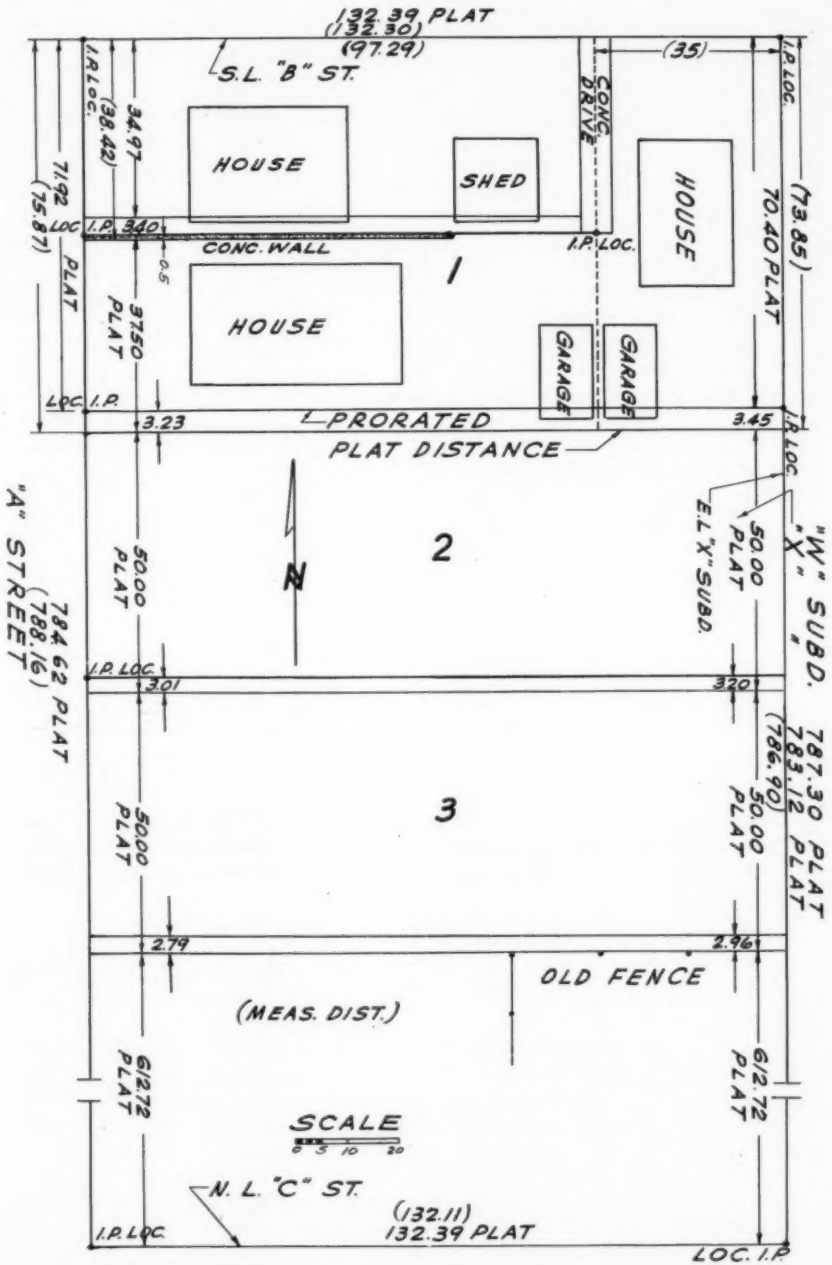
B Street was located in 1877, prior to the subdivision of the adjacent property, by the City Engineer. A plat was made and filed for record in the County Recorder's office. This plat shows that a couple of stones had been placed at each end of the survey, but their size was not indicated. One would have been approximately 700 feet east of the subdivision and the other about 1,600 feet west. The plat shows clearly that the street angled somewhat.

Before the subdivisions adjacent to B Street were laid out into lots, they were each a large tract, surveyed in 1864 and recorded at the country office. Wooden stakes were used, but again, no sizes were given.

The subdivision shown in the illustration was laid out into lots in 1890 by the County Surveyor, and also filed for record at the County Recorder's office. However, at that time only the block corners were set with $\frac{3}{4}$-inch pins. The ones now located may or may not be the original block corners.

A and C Streets are also indicated on the town plat as having been actually located, but I believe that the starting point of the original survey came from the street south of C Street. This thoroughfare was in use before 1864, and recent surveys show it to be, in substance, at the same location.

I next studied all plat and survey dimensions, as well as the measurements of B Street from the street south of C Street, and analyzed them. The result indicates that the subdivision dimensions (see illustration), when using plat distances, come closer to the original layout of B Street than the actual street survey indicates. Of course, an error may have been made in the actual location of B Street on the ground, as I mentioned before. "W" Subdivision, to the north of C Street and adjacent to "X" Subdivision to the east, was surveyed by a private


132.39 PLAT
(132.30)
(97.29)
S.L. "B" ST.
(35)
I.P. LOC.
CONC. DRIVE
I.P. LOC.
(38.42)
34.97
71.92
(75.87)
LOC
I.P.
3.40
HOUSE
SHED
HOUSE
70.40 PLAT
(73.85)
CONC. WALL
I.P. LOC.
0.5
1
HOUSE
37.50 PLAT
GARAGE
GARAGE
LOC. I.P.
3.23
PRORATED
PLAT DISTANCE
3.45
I.P. LOC.
"W." "X." SUBD.
E.L. "X" SUBD.
50.00 PLAT
2
N
"A" STREET
784.62 PLAT
(788.16)
50.00 PLAT
I.P. LOC.
3.01
3.20
787.30 PLAT
783.12 PLAT
(786.90)
3
50.00 PLAT
50.00 PLAT
2.79
2.96
OLD FENCE
(MEAS. DIST.)
612.72 PLAT
612.72 PLAT
SCALE
0 5 10 20
N. L. "C" ST.
(132.11)
132.39 PLAT
I.P. LOC.
LOC. I.P.

surveyor in 1899 and all individual lots were staked with ½-inch iron pins while ¾-inch iron pins, 3 feet long, were set at all block corners. The subdivision was completely recorded in conformance with State laws, and the dimensions were checked in the field by the City Engineer's office.

Although the block in question does not show many things out of order, there are, in my opinion, sufficient facts to indicate that the plat distances should be accepted. This conclusion has been supported by other conditions further down the block.

It is a good thing that one does not come across problems such as these very often, for sidewalks are in, the streets are paved, and houses have been up for from 30 to 50 years. In view of these facts, occupation rights should undoubtedly prevail. In this I take the same view as expressed in a letter written by Prof. Dodds who says he would be extremely reluctant to change old lines that have become fixed by occupation. One can prorate occasionally but not always. About one time in ten other solutions must be found. At least that has been my experience over the past 20 years.

The early history of this country indicates that survey practices differed and varied greatly. Standard methods such as we know today certainly did not exist. At present, when a new subdivision in a city is laid out by a surveyor, the City Engineer's office checks all measurements in the field. The same procedure is carried on in a county except that the Highway Department does the checking. Lot corners must have ⅝-inch iron pins and block corners, ¾-inch ones. The accuracy called for is about 1:10,000 in linear measurement.

* * *

New Surveying Specifications Adopted at Cleveland

SPONSORED and supported by the City of Cleveland, several surrounding suburbs, the county of Cuyahoga, and the Ohio State Highway Department, the Cleveland Geodetic Survey recently adopted specifications for use of the new Cleveland Geodetic Survey Control by plane surveying methods. This guide will enable city, county, state, and private practicing surveyors to make full use of the new system.

In contrast to accuracies of 1 in 5,000 which have been used in the past, the new specifications call for accuracies of 1 in 15,000 for control of streets and roads, and 1 in 10,000 for control of property lines. These accuracies are based upon some 25 miles of test runs made by S. A. Bauer, civil engineer and surveyor of Cleveland, over a period of years, with his field crews.

The new specifications follow the standards of accuracy recommended in the "Technical Standards for Property Surveys" adopted in 1946 by the American Congress on Surveying and Mapping. Being of relatively high order of precision, they were planned to extend the value of the work of the geodetic surveyor to the benefit of the end user—the property owner—without noticeable break.

Copies of the new specifications may be obtained from Prof. G. Brooks Earnest of the Case Institute of Technology and consulting director of the Cleveland Regional Geodetic Survey.—*Engineering News-Record*, January 22, 1948.

Sextant Plotting Device for Three-Point Problem

By EDMUND C. KNIGHT
CIVIL ENGINEER, U. S. ENGINEERS

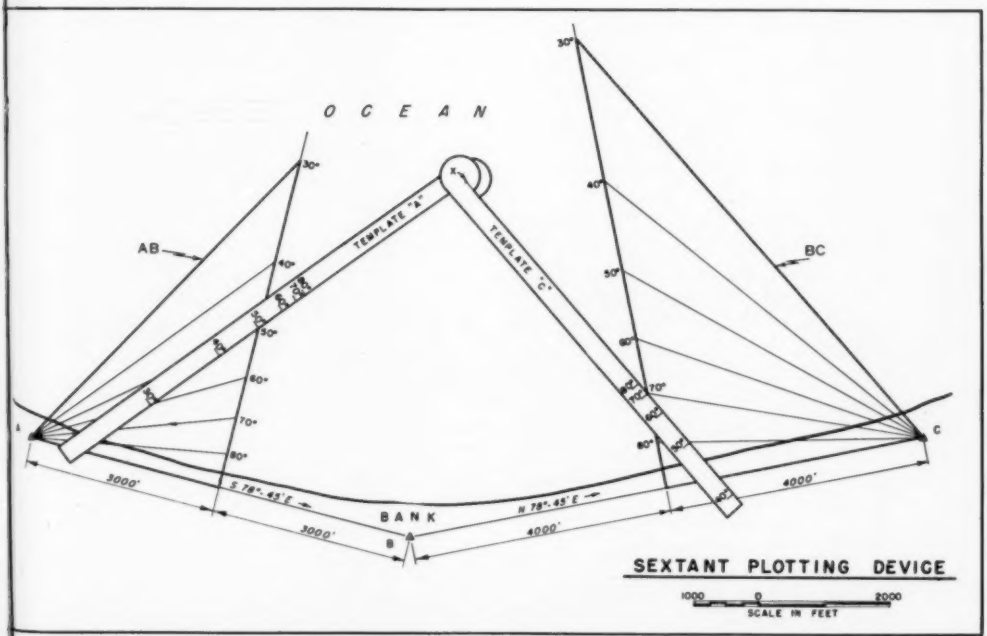
THE PURPOSE of the plotting device described in this article is to expedite plotting of hydrographic surveys when two sextant angles are used to locate the position of a boat.

The material required for making the device consists of two separate pieces of transparent material, which represent triangles *AB* and triangles *BC* in the illustration below. Templates "A" and "C" should also be made of transparent material of a rigid quality. At point *X*, the intersection of templates "A" and "C," a needle or pivot point is used.

Given: Course and distance between triangulation stations *A* and *B* and *B* and *C*.

Construction: Erect perpendiculars midway between *A* and *B* and *B* and *C*, and compute distances in 15′ intervals from 90° to 30°; then plot computed distances on each perpendicular.

For graduating template "A" in degrees and minutes use computations in triangle *AB* (the distances from the pivot point *X* along the arm correspond to the distances from *A* in the triangle to the perpendicular); for template "C," use computations in triangle *BC*.



For plotting the location of the boat's position, use observed sextant angles *XBA* and *XBC*. The illustration shows *XBC* as being 70° and *XBA* as 50°, *X* being the plotted position of the survey boat.

The advantage of using two separate pieces of material for each triangle is that the device may be used for various base lines and localities by increasing or decreasing the base line and shifting the perpendicular as required. Of course, it would be necessary to change the graduations on templates "A" and "C."

This device can be operated more rapidly than the conventional type three-arm protractor and certainly has many advantages over the construction of circles at 15′ intervals covering the area to be surveyed.

It has been determined through experience that to construct a protractor by means of circles with a radius varying from 18 inches to 36 inches, in 15′ intervals, is a tremendous task and may require more time than the actual survey.

With minor changes and adjustments which can be made in the field, this plotting device can be used for various localities or the same locality for a considerable length of time.

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Military Oceanography in World War II

IN AN ARTICLE with this title in a recent number of the *Military Engineer* (No. 259, Vol. 39, 1947, pp. 202–210), Lieutenant Colonel H. R. Seiwell describes the work of the United States Army's oceanographic units. Military oceanography comprehended the devising of field and laboratory techniques for obtaining required data and the analysis and presentation of these data. Chief among the contributions made were the development and application of methods for forecasting the state of the sea and the surf on target beaches and for surveying target coastal waters and beaches by aerial photography. The material prepared was made available in two forms: a daily hydrographic bulletin and a tidal illumination diagram. The bulletin provided an hour-by-hour forecast of such factors as height of surf, depth of water at breaking surf, distance from breaking surf to first available cover on beaches, heights and periods of waves in various relationships, directions and velocities of surface currents, and depth of water over beach obstacles. The tidal illumination diagram, of which an example is given (Omaha Beach, June 5 to 20, 1944), showed relationships between times of occurrence of high and low water and variations in solar illumination. Another interesting diagram for the supply phase of the Normandy operations is reproduced, showing relationships between surf heights and daily discharge tonnage (Omaha Beach, October 1 to 28, 1944).

The larger part of the experimental data obtained by the oceanographic units during the war has been turned over to the Woods Hole Oceanographic Institution, and, "as time permits, basic information resulting therefrom will be published." Colonel Seiwell concludes his report with a plea for continuing oceanographic research in the manifold phases of its military application, defensive as well as offensive.—*Geographical Review*, January 1948.

MAP INFORMATION

This department was inaugurated for the purpose of bringing to the attention of the members information pertaining to the availability of maps, surveys, etc., with particular emphasis on how such material can be procured. Authoritative articles covering this class of information are solicited. It is believed that through an interchange and dissemination of such information maximum benefits will accrue to the surveying and mapping profession. —EDITOR.

Aerial Mosaics of the United States

AN INDEX MAP, entitled "Aerial Mosaics of the United States," has recently been prepared by the U. S. Geological Survey for the use of Government agencies and the public in ascertaining the existence and availability of mosaics for areas of interest. This is the first published index of mosaic coverage in the United States. Within the past few years there has been an increasing demand for mosaics as a supplement to topographic maps, or aerial photographs used singly or in stereoscopic pairs. Consequently, areas for which mosaics have been prepared now amount to approximately one-fourth of the entire area of the United States.

In general, mosaics have not yet become a standardized product in the United States. Usually a mosaic is prepared to serve a particular need rather than to satisfy average needs of a wide range and variety of prospective users. Consequently standardized practice with respect to selection of projections, scales, format of title block and border information, nomenclature appearing within the image area, and related elements is the exception rather than the rule; the chief objective being the continuous photographic image of the earth's surface in units of area which otherwise require numerous individual aerial photographs for complete coverage. A highly important attendant objective is the photographic quality and tone gradation so necessary for easy identification of culture and small features.

As used in this text the term "mosaics" means an assemblage of aerial photographs whose edges have been torn, or cut, and then matched to form a continuous photographic representation of the earth's surface. Obviously, photo-index sheets, which are merely assemblies of untrimmed prints of a photography project made to show the relative locations of these prints for aid in selecting specific exposures for use, do not qualify as mosaics. During the past 5 years another term—"photo-maps"—has come into occasional use. This term is often used as a substitute for the term "mosaics." As used here, mosaics is intended to include photo-maps.

In view of the wide demand for mosaics, the need for an index map which provides ready information regarding the nearly three-quarters of a million square miles of available mosaic coverage is obvious. In the absence of a suitable index, Government agencies and the public have no means of determining whether a mosaic is available for areas in which they may be interested

except by establishing direct contacts with numerous agencies and commercial concerns. This is time-consuming and expensive.

The source data used in compiling this index consist of reports of available mosaic coverage from various federal agencies and from several commercial firms which reported holdings in response to a canvass of all active aerial photography concerns.

Information shown on the index map includes the extent of area covered by the mosaics of each agency or firm; dates (except in a few indefinite cases); and scales of copy negatives from which reproductions may be furnished.

At the time the index map was being printed several mosaic projects were under consideration, but completion of some of these projects was so uncertain that it was deemed advisable not to include any new projects in the first edition. Such of these as are completed will appear in the revised editions. For specified areas, information regarding these new projects is available upon request.

Copies of the index map together with addresses of the organizations from which mosaic reproductions may be obtained are available on request from the Map Information Office, U. S. Geological Survey, Washington 25, D. C.

MISSISSIPPI RIVER ALLUVIAL DEPOSITS DESCRIBED

A FOLIO of maps and diagrams and an accompanying report on "Fine-Grained Alluvial Deposits and Their Effects on Mississippi River Activity," have recently been released by the Mississippi River Commission, Corps of Engineers, U. S. Army. The report was prepared by Dr. Harold N. Fisk, consulting geologist to the Engineer Corps. The bound folio measures 15½ by 21½ inches and contains 74 plates printed by offset.

In general, the report details the investigations and describes the significance of the findings as analyzed from field examination, borings, and land and hydrographic surveys. Throughout it refers to the detailed maps, diagrams, profiles, sketches, and photogrammetric interpretations printed in the folio volume. The two volumes, which are essentially interdependent and not designed to be separate analyses, represent a vast amount of survey work and examination of the behavior of the river and valley over a period of many years. Certain information is drawn from the 15th (1947) edition of "Maps of the Mississippi River" (see SURVEYING AND MAPPING, July–December 1947, p. 224).

The project is divided into four major parts: general river characteristics and features of the alluvial plain; origin and physiographic expression of each type of deposit; physical properties of the sedimentary units; and the effects of fine-grained deposits on channel migration, bank caving, and meander loops.

The two volumes are sold as a set at $2.50. Remittance by money order or certified check, payable to the Treasurer of the United States, may be sent to the Mississippi River Commission, Corps of Engineers, P. O. Box 80, Vicksburg, Miss.

NEW MAP OF MALAYA

THE SURVEY DEPARTMENT of the Malayan Union and Singapore has published a new map of Malaya, No. 15, 1948, on a scale of 12 miles to the inch

and covering an area of approximately 1° to 7° North latitude, and from 100° to 104° 15′ East longitude.

The map base is black on white paper, delineating culture, drainage, and grid. Water areas are blue and main roads are overprinted in red. Orange, yellow, green, and pink are used for the overprint of political areas. Full degree and 30′ marks are so numbered in the map border, which contains a continuous graphic scale of 12 divisions to each degree of grid. No projection is shown. Approximate size of the map is 24 by 33 inches.

Sixth Annual Illinois Conference on Surveying

THE SIXTH Annual Illinois Conference on Surveying and Mapping was held at Navy Pier, Chicago, on May 7–8, 1948. This meeting, the first since 1942, was sponsored by the Departments of Civil Engineering at the University of Illinois and Illinois Institute of Technology, and by the Division of Engineering Sciences, Navy Pier Branch of the University of Illinois. The program sought to focus attention on surveying and mapping in relation to urban planning, although three papers were devoted primarily to technical and legal aspects of land surveying.

Prof. G. Brooks Earnest, Case Institute of Technology, in a paper on the Cleveland Geodetic Survey, described the Survey as unique because of its methods of obtaining funds and maintaining the organization. The advantages of "The Use of Geodetic Control in Surveying Practice" were discussed by S. A. Bauer, Bauer Surveys Company, Cleveland. William T. Laidly, U. S. Lake Survey, Detroit, described some aspects of the crustal movement or earth tilt occurring in the Great Lakes basin in his paper on the activities of the Lake Survey.

Other papers included: "Utility Maps in Planning Studies," by Robert Kingery, in which he asserted that only about 10 of the 275 municipalities in the Chicago area have adequate maps; "Aerial Surveying in Urban Mapping," by Talbert Abrams, President, Abrams Aerial Survey Corp.; "Highlights in the History of the Illinois and Michigan Canal, by D. D. Anderson, Illinois Division of Waterways; "Survey of the Illinois and Michigan Canal," by L. E. Alswede, District Engineer, Illinois Division of Waterways; and "Guaranteeing a Title," by Logan D. Fitch, Assistant Vice-President, Chicago Title and Trust Company, in which he emphasized the importance of land descriptions which are sufficient to constitute "constructive notice" to subsequent purchasers. Prof. J. C. Penn, Illinois Institute of Technology, presented each delegate with a copy of his "Suggestions and Problems for the Study of Land Surveying," an outline of topics to be studied by candidates for the Licensed Surveyor's examination in Illinois, which was discussed by Prof. Penn and the audience.

The American Congress on Surveying and Mapping was well represented among the delegates and participants in the conference program. Past Presidents George D. Whitmore and John S. Dodds were present, the latter presiding for part of the sessions. Other Congress members present were Messrs. Bauer, Rayner, Abrams, Brooks Earnest, D. D. Anderson, and Penn.

Milton O. Schmidt, Assistant Professor of Civil Engineering, University of Illinois, is Director of the Illinois Surveying Conference.

MILTON O. SCHMIDT

Surveying and Mapping News

Members are requested to send in surveying and mapping news items for publication in SURVEYING AND MAPPING.—EDITOR.

CURRENT SURVEYING AND MAPPING LITERATURE

MAGAZINE ARTICLES

THE APPLICATION OF THE NATIONAL COORDINATE SYSTEM TO CADASTRAL SURVEY AND TITLE DEEDS. O. C. Gibbins, *The Australian Surveyor*, June–September 1946. (Brief history of use of coordinate systems in the United States, with comments on model bill promulgated by the Coast and Geodetic Survey for adoption by state legislatures.)

THE EARLY MAPS OF SAN FRANCISCO BAY PRIOR TO THE AMERICAN PERIOD (1769–1847). Neal Harlow, *Navigation*, December 1946.

THE READJUSTMENT OF EUROPEAN TRIANGULATION. Floyd W. Hough, *Transactions, American Geophysical Union*, February 1947.

VEHICULAR ODOGRAPH. A. G. McNish and B. Tuckerman, *Terrestrial Magnetism and Atmospheric Electricity*, March 1947. (A device, for automatically plotting course of vehicle, which derives direction from magnetic compass read by photoelectric systems and distance from shaft geared to speedometer cable.)

UNRESOLVED PROBLEMS IN GEOGRAPHICAL NOMENCLATURE. M. Aurousseau, *The Scottish Geographical Magazine*, April 1947. (Some aspects of international geographic nomenclature, with an approach to agreement on names.)

SOME DEVELOPMENTS IN THE USE OF AIR PHOTOGRAPHS FOR FOREST SURVEYS. H. E. Seely, *The Canadian Surveyor*, April 1947.

LENGTHS OF LONG LINES. J. F. Fredette, *The Canadian Surveyor*, April 1947. (Describes a method for finding the length of the arc of a great circle joining two known points.)

SOME THOUGHTS ON ENGINEERING EDUCATION. Donald M. Baker, *Proceedings, American Society of Civil Engineers* (Part 1), June 1947. (Concluding remarks by author of original article of same title published in the April 1946 *Proceedings*. Previous discussions appeared in *Proceedings* as follows: September 1946, October 1946, December 1946, February 1947, and May 1947.)

SURVEY INSTRUMENTS: HISTORIC AND PREHISTORIC. A. J. Cutten, *The South African Survey Journal*, June 1947.

GLACIER RECESSION IN MUIR INLET, GLACIER BAY, ALASKA. William O. Field, Jr., *The Geographical Review*, July 1947. (Describes variations of Muir Inlet glaciers which are presented in considerable detail by an accompanying map.)

VEHICLE BORNE INSTRUMENT FOR CONTINUOUSLY INDICATING ROAD ELEVATIONS. D. Silverman, J. D. Eisler, and J. F. Evans, *Geophysics*, July 1947. (Describes an electromechanical device mounted in a moving vehicle which indicates differences in elevation between successive points along a traverse.)

TRANSFER OF LEVELS ACROSS WATER. R. H. Montgomery, *The Canadian Surveyor*, July 1947. (Describes procedure for transferring levels across water used in Canada.)

MODERN MAPPING—INCLUDING EMPLOYMENT OF RADIO TECHNIQUES AND WITH SPECIAL REFERENCE TO ECONOMIC DEVELOPMENT. C. A. Hart, *Empire Survey Review*, July 1947. (Report on experimental surveys incorporating application of Radar.)

HOW TO SPEED UP SLIDE-RULE WORK. Lee Johnson, *Engineering News-Record*, July 24, 1947. (Describes an improved "center-drift method" permitting more efficient use by substituting the eye and head for the hand.)

PORTABLE ECHO-SOUNDING RECORDER SPEEDS HYDROGRAPHIC SURVEYS. *Engineering News-Record*, July 24, 1947. (Describes an instrument, specially designed to record relatively shallow depths with high accuracy, being tested by the Corps of Engineers.)

OCEANOGRAPHY IN THE HYDROGRAPHIC OFFICE. Charles C. Bates and Richard H. Fleming, *The Military Engineer*, August 1947.

SPHERICAL TRIANGLES MADE PLANE. Ernest P. Carmody, *The Nautical Magazine*, August 1947.

OBOE—A PRECISION RADAR SYSTEM. M. G. Scroggie, *Radio News*, August 1947. (Describes a highly accurate position-finding system which can automatically release a bomb or activate a camera on an airplane over any desired point.)

GEOGRAPHY IN WAR AND PEACE. E. G. R. Taylor, *The Advancement of Science*, September 1947. (An address by the president of Section E (Geography), British Association for the Advancement of Science.)

METHODS OF SUPPLEMENTING GEODETIC CONTROL. Duane Lyon, *Photogrammetric Engineering*, September 1947. (Graphic radial, monocular analytical, and stereo triangulation methods for obtaining supplementary control are described.)

THE AERIAL PHOTOGRAPH. H. E. Sostman, *Air Trails*, September 1947. (Discusses techniques of mapping large areas by aerial photography, including trimetrogon system.)

PROBLEMS IN MAP EDITING. Edward B. Espenshade, Jr., *Scientific Monthly*, September 1947. (Comprehensive discussion of all phases of map editing, including types, production methods, sources, reliability, and place names.)

SYMPOSIUM OF IDEAS RELATIVE TO EDUCATION IN PHOTOGRAMMETRY. *Photogrammetric Engineering*, September 1947. (Includes some 30 contributions by photogrammetric engineers, instructors, and others concerning courses in photogrammetry and qualifications for photogrammetric work.)

TILT BY THE GRAPHICAL PYRAMID METHOD. G. T. McNeil, *Photogrammetric Engineering*, September 1947. (Describes a direct graphical solution of the tilt problem.)

PALESTINE'S JORDAN RIVER VALLEY PLAN EMULATES TVA DEVELOPMENT. Erwin E. Shalowitz, *Civil Engineering*, September 1947. (A general discussion of proposed "Jordan Valley Authority" for developing available power and irrigation resources in Palestine.)

OUR NAVY EXPLORES ANTARCTICA. Richard E. Byrd, *National Geographic Magazine*, October 1947. (An account of the 1946–1947 U. S. Navy Antarctic Expedition, officially designated "Operation Highjump.")

THE NORTHERN ALASKAN COASTAL PLAIN INTERPRETED FROM AERIAL PHOTOGRAPHS. Edward C. Cabot, *The Geographical Review*, October 1947.

THE EARTH'S MAGNETISM. J. A. Fleming, *Think*, October 1947. (Discusses principals and characteristics of the earth's magnetism.)

WAVE EROSION ALONG THE SOUTHERN CALIFORNIA COAST. F. P. Shepard and U. S. Grant IV, *Bulletin of the Geological Society of America*, October 1947. (Discusses factors of wave erosion and results based on measurements spaced over the past 28 years.)

A HISTORY OF MAP MAKING. *The Canadian Surveyor*, October 1947. (A brief survey of important historical maps. Article reprinted from the *Imperial Oil Review*.)

TOPOGRAPHIC MAPPING IN UNITED STATES. C. F. Fuechsel, *Journal of Forestry*, November 1947. (Describes use of topographic maps in various phases of forest protection, utilization, and general management activities.)

SURVEYS IN THE MISSOURI RIVER BASIN. Leo Otis Colbert, *The Military Engineer*, December 1947.

CITY PLANNING IN CHICAGO. Robert C. Klove, *The Geographical Review*, January 1948. (A review of the principal publications issued by the Chicago Plan Commission since 1940.)

SHORAN RADAR. E. B. Stern, Jr., *Oil and Gas Journal*, January 15, 1948. (Describes use of Shoran in connection with 80,000 square mile airborne-magnetometer survey in Bahama Islands and for land surveying work for refraction seismograph survey in West Texas.)

MAP PROJECTIONS FOR MODERN CHARTING. Albert A. Stanley, *The Military Engineer*, February 1948. (Describes map projections commonly used and their application in present-day charting.)

MISSOURI RIVER BASIN DEVELOPMENT. Lewis A. Pick, *The Military Engineer*, March 1948. (A discussion of the Pick-Sloan plan for the Missouri River Basin.)

METHOD SIMPLIFIES LAND–LEVELING OPERATION. Leon S. Stanley, *Civil Engineering*, March 1948. (Land leveling is discussed in its relation to irrigated farms where water conservation is highly essential to maximum beneficial use.)

THE PLACE OF MAPS IN SOCIAL EDUCATION. Katheryne Thomas Whittemore, *The Journal of Geography*, March 1948. (A short dissertation on map reading and the proper use and evaluation of different types of maps.)

SHORAN FOR SURVEYING. W. F. Kroemmelbein, *Electronics*, March 1948. (Army Air Force tests indicate that Shoran has advantages over ground triangulation and astronomic control for many geodetic survey, photo mapping, and geophysical prospecting jobs.)

A MULTIPLE ALIGNMENT NOMOGRAM FOR THE SAG CORRECTION OF A STEEL SURVEYING TAPE. R. Sacks, *Empire Survey Review* (London), April 1948. (Describes the development of a graphical representation for determining the correction to be applied to lengths measured with a steel tape in catenary.)

SOME CORAL REEFS OF THE SAHUL SHELF. Curt Teichert and R. W. Fairbridge, *The Geographical Review*, April 1948. (Describes and illustrates coral reefs of the Sahul Shelf, an enormous submerged area bordering the north of Australia.)

SURVEYING UNDER DURESS. W. H. E. Neil, *Empire Survey Review* (London), April 1948. (Experiences of a British sergeant in surveying and mapping a prisoner-of-war camp while interned by the Japanese on Singapore Island.)

THE 1:1,250 RE–SURVEY OF GREAT BRITAIN. R. P. Wheeler, *Empire Survey Review* (London), April 1948. (Describes the scope and techniques, including control, detail survey, and plotting, of the resurvey of Great Britain.)

MAPS ARE HIS BUSINESS. Ralph Yambert, *Flying*, May 1948. (Describes a special map case developed by a United Air Lines pilot to solve the problem of bulky maps.)

"LOCATION BY AGREEMENT." W. H. Mills, *The Military Engineer*, May 1948. (Describes a proposed uniform referencing system for maps employed in military operations.)

MAJOR STRUCTURAL FEATURES OF THE WESTERN NORTH PACIFIC. H. H. Hess, *Bulletin of the Geological Society of America*, May 1948. (The paper accompanies H. O. chart 5485, a bathymetric chart of the area from Korea to New Guinea, recently published by the U. S. Hydrographic Office.)

BOOKS AND PAMPHLETS

THE VOYAGE OF CAPTAIN BELLINGSHAUSEN TO THE ANTARCTIC SEAS, 1819–1821 (in two volumes). Translated from the Russian. Edited by Frank Debenham. *The Hakluyt Society*, London. 1945. Vol. I—pages 1–259; Vol. II, pages 261–474. (The first full English translation describing discoveries and surveys of the famous Russian expedition.)

CHARTING THE SEAS IN PEACE AND WAR. *His Majesty's Stationery Office*, London. 1947. 24 pages. (The story of the Hydrographic Department of the British Admiralty over 150 years.)

YANKEE SURVEYORS IN THE SHOGUN'S SEAS. Edited by Allen B. Cole. *The Princeton University Press*. 1947. 160 pages. $2.50. (Contains records of the United States Surveying Expedition to the North Pacific Ocean, 1853–1856.)

DATA BOOK FOR CIVIL ENGINEERS, VOLUME III, FIELD PRACTICE. Elwyn E. Seelye, *John Wiley & Sons, Inc.*, New York. 1947. 306 pages. $4.50. (A handbook for the engineer in the field covering practically every aspect of civil engineering, including surveying and mapping.)

SURVEYING INSTRUMENTS. Edmond R. Kiely. *Columbia University*, New York. 1947. 411 pages. $3.00. (To be reviewed in a later issue of SURVEYING AND MAPPING.)

PROPOSED STANDARD SYMBOLS FOR AERONAUTICAL CHARTS (Doc 2700-A, MAP/130–A). *International Civil Aviation Organization*, Montreal, Canada. 1947. 19 pages. $0.45 (Canadian). (English, French, and Spanish in same volume.) (Compilation of conventional symbols recommended as standard, superseding the previous "Standard Symbols." Also includes typefaces, colors, and diagrams for instrument approach and landing procedures.)

THE CONSTRUCTION OF NOMOGRAPHIC CHARTS. F. T. Mavis. *International Textbook Company*, Scranton, Pa. 132 pages. $2.25. (A valuable guide to the use of alignment charts or nomographs in solving many functions of three or more variables by laying a straightedge across three scales and reading directly the desired values.)

LEWIS AND CLARK—PARTNERS IN DISCOVERY. John Blakeless. *William Morrow and Company*, New York. 498 pages. $5.00. (Contains a detailed map of the exploration route.)

NATURAL TANGENTS. R. B. Huey. *Parker & Company*, Los Angeles. 1948. 630 pages. $15.00. (Described elsewhere in this issue.)

THE HOBBS GUIDES. *Rand McNally & Company,* Washington, D. C. 1948. 50 cents. (The series of three guides provide complete touring information of western United States.)

NEW YORK STATE PLANE COORDINATE PROJECTION TABLES. *U. S. Coast and Geodetic Survey,* Washington, D. C. 1948. 25 pages. Furnished free on request.

1,000 PLACE NAMES IN CALIFORNIA. *The University of California Press.* 96 pages. $1.00. (The origin of selected place names based on the research conducted for the forthcoming geographic dictionary, *"California Place Names,"* to be published in 1948.)

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Curriculum in Surveying and Mapping Graduate School, U. S. Department of Agriculture

THE GRADUATE SCHOOL of the United States Department of Agriculture, Washington, D. C., announces its curriculum in surveying and mapping for the Fall Term of 1948. Recognizing the important part that maps have played in human progress, and the increasing demand for persons qualified in the various technical phases of map production, the School has broadened its curriculum, based on the findings of its Engineering Advisory Committee, looking towards the eventual inclusion of a complete course leading towards a Master's Degree in Surveying and Mapping.

The purpose of the new curriculum is to offer basic training for those persons who are engaged in the technical and supervisory aspects of map making. The curriculum is intended to give the student a broad knowledge and basic understanding of each of the separate phases of the science and to enable him to understand better the problems, possibilities, and limitations of each of the phases so that he can plan his own activities in closer harmony with others toward the economical production of accurate maps. A large part of the curriculum is devoted to geodesy, a subject considered to be of increasing importance in view of modern rapid means of world-wide travel, the consequent need for world-wide charts, and the developments of new methods in surveying.

At least 2 years' work toward a degree of Bachelor of Science in Civil Engineering is considered as being the logical background for the curriculum in surveying and mapping, although one who has completed 2 years in engineering normally would have fulfilled all the prerequisites.

Further information regarding the details of the curriculum may be obtained by writing to the Graduate School, U. S. Department of Agriculture, Washington 25, D. C.

Books in Review

MANUAL OF COASTAL DELINEATION FROM AERIAL PHOTOGRAPHS. (H. O. Pub. No. 592.) P. G. McCurdy. *U. S. Hydrographic Office*, Washington, D. C. 1947. 143 pages. $1.50.

Reviewed by Capt. K. T. Adams, Chief, Division of Photogrammetry, U. S. Coast and Geodetic Survey, Washington, D. C.

This manual is a valuable contribution to the profession of cartography, and is unique in that it presents the natural processes by which the coastlines of the world are developed in such a manner as to be readily applied by the practicing photogrammetrist and cartographer to the involved problems of interpretation and compilation of coastal features from aerial photographs.

The author is well known to photogrammetrists and others for his work at the Hydrographic Office, his Manual of Photogrammetry, and his work as editor of *Photogrammetric Engineering*. In this manual he has applied his extensive experience in mapping coastal areas to the task of assimilating the available material on the geomorphology of coastlines and has presented a practical working manual summarizing the natural processes of coastal development, together with procedures for delineation of coastal features. The result is a valuable reference book, whether the immediate task is the field examination and interpretation of photographs, the compilation of manuscript maps from photographs, or the compilation of nautical charts from the work of both the photogrammetrist and hydrographer.

The manual is profusely illustrated with well-chosen diagrams and reproductions of stereoscopic pairs of aerial photographs. These are invaluable to the ready and accurate understanding of the text, and are an outstanding feature of the book.

Of particular interest is the practical recognition of the fact that complete and accurate delineation of the shoreline and adjacent offshore features can never be accomplished by the office photogrammetrist alone, but will always require the field interpretation of the aerial photographs, and usually additional data from the inshore hydrographic surveys.

The manual is conveniently arranged in seven chapters: Introduction, Definitions, Types of Coasts, Coastal Items to be Mapped, Manuscript Symbols, Recommended Procedure for Delineation of Coastal Features, and Illustrated Problems in Delineation of Coastal Features.

The generic terms for some coastal features and their respective definitions have not been satisfactorily standardized and there is a tendency in current literature to apply some of the terms ambiguously. The terms and definitions given in Chapter II are an excellent working choice for the cartographer and are well illustrated with diagrams. The term "storm water line," that is, the inland limit of the wave-deposited debris, might be added to Chapter II for the practical use of the photogrammetrist and cartographer. The term is often convenient to describe a line which must be distinguished from the shoreline or high-water line.

In Chapter III, the coastlines of the world are divided into seven major types, and the development and salient characteristics of each type are ably described and well illustrated. This chapter is particularly important and interesting to those engaged in the compilation of coastal areas, since it presents such a wealth of material to assist in the interpretation of aerial photographs.

Chapters IV and VI, in addition to discussing and describing the features to be mapped and recommending procedures, discuss the difficulty of determining depths of underwater features from aerial photographs, and the need for inshore hydrographic surveys to delineate completely the features offshore from the high-water line.

The inclusion in Chapter V of manuscript symbols as recommended by the Joint Mapping and Photograph Committee is convenient, and the illustrated problems in delineation, in Chapter VII, should be particularly helpful.

In the last paragraph of Chapter I and in other parts of the manual, the author stresses the fact that the photogrammetrist often has to interpret coastal features without adequate field inspection data. In time of war this is often an unavoidable condition, but it should not be accepted as an unavoidable condition for peacetime mapping.

PRACTICAL AIR NAVIGATION. Commercial Edition. Thoburn C. Lyon. *Privately printed, 8814 Reading Road, Silver Spring, Md.* Sixth Edition. 1948. 356 pages. $2.50.

Reviewed by HELMUTH BAY,
Rand McNally & Co., Washington, D. C.

THIS IS THE 1948 commercial edition of the standard Government text by the same author and is intended to replace the latter which is now four years old and quite obsolete.

The new edition is more complete, more thorough, and better organized. New features (such as the "study guide for private pilots," and a section giving answers to problems) emphasize the more practical approach.

While new material has been included for professional flyers, such as the new chapters on electronic navigation and on pressure pattern flight, the book has also been made more useful for the amateur. There is an entirely new chapter on light plane navigation.

Accompanying the publication is a complete Sectional Aeronautical Chart with portions of available smaller scale charts of the same area, and a brief descriptive text, printed on the back. This makes it possible, on one piece of paper, to work out complete chart problems, from planning charts to flight charts, and to compare the treatment of the same area on charts of different scales.

CLARK ON SURVEYING AND BOUNDARIES. Frank Emerson Clark. *The Bobbs-Merrill Company*, Indianapolis, Ind. Second Edition. 1939. (New printing, 1948, now available.) 896 pages. $6.00.

Reviewed by WALTER S. DIX,
Maps and Surveys Division, Tennessee Valley Authority

THE AUTHOR of this treatise on the law of surveying and boundaries has been both a public and private surveyor, as well as a practising member of the Minnesota Bar. The book does not deal with the geometry and physical elements of surveying, as its title may imply, but is rather a digest of the laws pertaining to surveying—a guide to surveyors throughout the country in the surveying and subdivision of lands of private owners, in accordance with existing land laws and regulations, and in conformity with the laws as construed by the courts.

An invaluable reference work for both the practising surveyor and lawyer, this book could well be used as a textbook in surveying schools to supplement the technical training in engineering surveys with the legal phases of land surveying. Over a thousand court cases are listed for reference in support of decisions made and opinions stated throughout the 29 chapters of the book.

The introductory chapters include background material on land surveying, including history, definitions, and procedures used in the states surveyed under the Public Lands

system. Chapters are also devoted to surveys of the Original Thirteen States and the rectangular system used in Canada. Chapter 28 summarizes State laws and decisions concerning surveyors, boundaries, and landmarks; and Chapter 29 explains the State Systems of Plane Coordinates. An appendix contains a bill enacting the "Maryland Coordinate System."

Other chapters on adverse possession, liabilities, highways, dedication and estoppel, descriptions, evidence of location of corners, lost corners, riparian rights, agreements, etc., make the book an outstanding reference for the surveyor, lawyer, engineer, landowner, and student.

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NATURAL TANGENTS TO EIGHT PLACES

A RECENTLY published volume, Natural Tangents to Eight Decimal Places for Every Second of Arc, by R. B. Huey, seems to fill a definite need, in view of the increasing use of machine calculations, which favors the use of natural functions.

In addition to the eight-place natural tangents from 0° to 90°, the book contains useful tables of "Minutes in Decimals of a Degree" and "Lengths of Arcs of Circles to the Radius 1." Also included are tabulated differences of basic computations between the tangents of Andoyer and Rheticus, which will help explain the slight discrepancies between cotangents in the first part of the book and tangents in the second part, due to the adjustment of the second part to the Andoyer Table.

A preface in both English and Spanish gives a brief history of the tables and explains their use. Printed by offset, the book contains 630 pages with a 6¾ by 10½-inch format. It is substantially bound in dark red pebble-grain cloth and is priced at $15 a copy. The publishers are Parker & Company, 241 East Fourth St., Los Angeles 13, Calif.

—W. S. DIX

DRAWINGS AND DRAFTING ROOM STANDARDS REVISED

IN RESPONSE to widespread requests from engineers and others who found the first edition of "Drawings and Drafting Room Practice" helpful in standardizing drafting room procedures, the American Standards Association has issued a revised edition of this manual—the first since 1935. Sponsor organizations are the American Society for Engineering Education and the American Society of Mechanical Enginners.

Authorized in 1940, the present revision covers the enormous expansion in the use of graphics resulting from war industry, and the development of techniques that have come into common use. Other items covered in this 53-page standardization of American practice include the arrangement of views, line work, dimensioning, sheet sizes, and lettering.

The manual may be purchased from the American Society of Mechanical Enginners, 29 West 39th Street, New York 18, N. Y. The price is $1.50.—*Civil Engineering,* February 1947.

Comment and Discussion

The pages of SURVEYING AND MAPPING are open to a free and temperate discussion of all matters pertaining to the interests of the CONGRESS. It is the purpose of this Department to encourage comments on published material or the presentation of new ideas in an informal way. —EDITOR

REGULATIONS AND INSTRUCTIONS FOR SURVEYS

SERGE A. EMERY.*—In the editorial "Coordination of Surveys," first printed in the *Engineers' Bulletin* of the Colorado Society of Engineers, dated January 1947, and reprinted in SURVEYING AND MAPPING for June 1947, there is emphasized the necessity for the establishment of a survey bureau. This bureau would control land surveys of all kinds: townships, city subdivisions, roads, and streets. Only after this control has been made could the maps be recorded in the bureau. In this way, inaccuracies and lack of co-ordination in those surveys could be corrected. Engineers doing this type of work would thus be able to save much time and effort in fitting old and inaccurate surveys together. The maps and drawings controlled could then be considered documents of authority and enjoy the confidence of engineers and all people interested in these maps. The thought is a sound one, and it is in the direction of more efficient service to all. Taking into consideration the steady increase of population and the parallel increase of land values, it becomes increasingly necessary to execute all measurements of land with the utmost precision.

The above-mentioned reasons corroborate the necessity and appropriateness of this idea. In order to carry this proposal into reality, much time and work of specialists and experts is required. For the successful function of this control, it would be necessary to establish a number of controlling offices in proper areas throughout the country. In this way, the work could be done quickly and more efficiently. Engineers and surveyors could contact the controlling staff or bureau and give and receive necessary information. Thus all errors and faults might be spotted and corrected efficiently. One central bureau consisting of competent engineers would be established to control the various local offices. This central office would make suggestions and decisions in cases of disputes and new problems.

Before these bureaus start functioning, however, it is necessary to establish regulations and instructions for all engineers and surveyors defining the order of preciseness of their work, standards, scales, limits of errors, preciseness of measurements and plotting, and information to be included in all maps. These regulations must be made compulsory for control offices as well. The instructions should contain different types of illustrative examples explaining the problems to the engineer and helping him visualize them.

The idea of establishing control offices which distribute information to surveyors and engineers is a good one because it will enable the engineer to make a

* Professional Civil Engineer, New York, N. Y.

map or plan more efficiently, as well as establish a uniform system of control. The task of preparing the instructions is a tremendous one, if the information is to be modern and cover all types of surveying work for all areas in the United States. It will require the skills of specially trained experts in all fields of surveying.

Perhaps the newly formed Joint Committee for New York State can commence work on preparing instructions which are necessary under the considered plan. This committee is part of a nation-wide movement to bring about more uniformity in the surveying and mapping of lands. Its chairman is Prof. H. Oakley Sharp. Possibly this committee can create sufficient interest to enable the government to undertake the financial responsibilities involved in the plan, such as was done in most states of Europe.

Only after a set of well-found regulations and instructions have been fully prepared and distributed to all engineers and surveyors desiring them, and only after these control offices begin functioning properly and effiectively, can maps and plans drawn today become useful and trusted documents, not only in these times but to future generations.

"SYNACTIC" MAPS?

KENNETH RAMROD DEARDORF.—Since no universally accepted term at present exists for that class of maps which consists of a more-or-less topographic base upon which is superimposed non-topographic information, both delineations combining to present the message, the name *synactic* is suggested, in an effort to provide such a universally acceptable term.

The derivation, like so much of our cartographic and mathematical terminology, is Greek, and the word means "acting together, cumulative in effect" (Webster), which is exactly what happens with this kind of map. It is argued that the term is concise, easily pronounced and remembered, and sufficiently comprehensive to include the entire field of such class of maps, whether "statistical," "dynamic," "pictorial," "isopleth," "economic," or what-have-you, but excluding diagrams and many so-called cartograms not based on real topographic forms. These latter are not maps, anyway, and belong in a class by themselves, probably along with graphs and curves and the like.

Terms in present use to describe this class of maps vary from user to user, and usually are more strictly applicable to some variety under the general type. They are not wide enough in meaning to cover the entire class, which is probably the reason none of them has become universally acceptable—although any of them may be highly descriptive of its own variety. However, all these varieties have one feature in common: they consist of two parts; (1) a topographic base, and (2) superimposed non-topographic information—and both of these *act together* to present a message, which would not be complete lacking one or the other. Thus they can all be grouped together under the inclusive term "Synactic Maps," and we shall at last be able to define in one short, natural, meaningful word something for which we have had previously no even adequately descriptive phrase.

It is hoped that this suggestion will merit serious consideration, or at least lead to discussion eventuating in the development of such a term as everyone can agree upon. There is a very empty space in our terminology.

CONGRESS NEWS

Officers of the Congress, 1948-49

Marshall S. Wright, Technical Assistant to the Chief, Office of Plant and Operations, Department of Agriculture, has been re-elected President of the Congress for the year 1948–49, it was announced at the Eighth Annual Meeting. (For a biographical sketch of Mr. Wright, see SURVEYING AND MAPPING, July-December 1947.) George H. Harding, Research Professor of Civil Engineering at Ohio State University, was elected Vice-President.

The Board of Directors approved the appointment of the following additional officers: Walter S. Dix, Executive Secretary; Richard T. Evans, Treasurer; and A. L. Shalowitz, Editor-in-Chief.

NEW MEMBERS

BECKLEY, LUTHER D., Civil Engineer and Surveyor, 166 Colorado Ave., Highland Park 3, Mich.

BOWERSOX, G. ROBERT, Photogrammetric Engineer, U. S. Coast and Geodetic Survey; 305 7th St., N. E., Washington 2, D. C.

CLARKE, F. T., Chief Civil Engineer, Union Sulphur Co., Inc., Sulphur, La.

DEL CASTILLO, DR. CARLOS JOSE, Quinta Elba, Av. la Estrella, San Bernardino, Venezuela, South America

ESPENSHADE, EDWARD B., JR., Professor of Geography, Northwestern University; 596 Sheridan Sq., Evanston, Ill.

FITZGERALD, ISAIAH Y., Cartographer, Box 1292, New Bern, N. C.

JOHNSTONE, HARRY E., President, Hi-Wa Map Co., 1525 N. Cahuenga Blvd., Hollywood 28, Calif.

JUNGERS, ALFRED F., Captain, Survey Officer, 29th Division Artillery; 29 Edmondson Ridge Rd., Baltimore, Md.

LEWIS, E. ROBERT, Civil Engineer, 109 Park Ave., Plainfield, N. J.

MOSELOWITZ, HERMAN G., Civil Engineer, 7 Spring St., New Brunswick, N. J.

NATELLA, FRED, Lieutenant Commander, U. S. Coast and Geodetic Survey, Washington 25, D. C.

SMIRNOFF, MICHAEL V., Civil Engineer, Department of Engineering, University of California, Los Angeles 24, Calif.

SUGGS, ROBERT L., President, Offshore Navigation, Inc., 3503 Fern St., New Orleans, La.

SUTCLIFFE, DRAPER KRUM, Civil Engineer, 2916 B Fordleigh Rd., Baltimore, Md.

SWEETSER, STANLEY R., Surveyor, Dennisport, Mass.

WARNER, EARL M., Civil Engineer and Land Surveyor, 3101 33rd Ave., Sacramento, Calif.

WONG, PAUL, Cartographer, U. S. Coast and Geodetic Survey; 1719 Harvard St., N. W., Washington 9, D. C.

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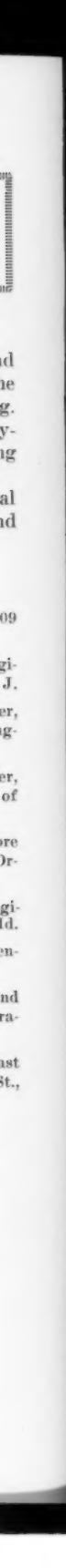
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